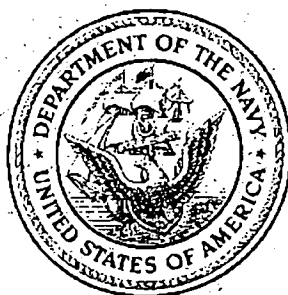


Action Memorandum

**Site 11 - Fire Training Area (FTA)
Naval Air Station
Brunswick, Maine**



**Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 151**

October 1994

ACTION MEMORANDUM

SITE 11 - FIRE TRAINING AREA (FTA)
NAVAL AIR STATION
BRUNSWICK, MAINE

INSTALLATION RESORATION PROGRAM

Submitted to:
Northern Division
Environmental Branch, Code 18
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

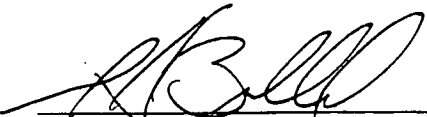
Submitted by:
Halliburton NUS Corporation
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Wayne, Pennsylvania 19087

CONTRACT NUMBER N62472-90-D-1298
"CLEAN" Contract Task Order No. 151

October 1994

SUBMITTED FOR HALLIBURTON NUS BY:

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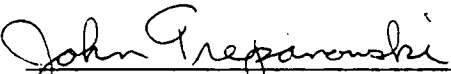

JOHN TREPANOWSKI
PROGRAM MANAGER
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1.0 PURPOSE

This Action Memorandum documents the U.S. Department of the Navy's (Navy) proposed removal action at Site 11, the former Fire Training Area (FTA), on the Naval Air Station (NAS) Brunswick in Brunswick, Maine. The removal action will be conducted in accordance with conditions identified in the Federal Facility Agreement (FFA) among the Navy, the U.S. Environmental Protection Agency (USEPA), and the Maine Department of Environmental Protection (MEDEP), by authority of Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Navy notified the USEPA of its intent to pursue a "time-critical" removal action in accordance with Section 300.415 of the National Contingency Plan (NCP) for buried drums at Site 11. The proposed removal action includes removing drums, miscellaneous containers, and heavily contaminated soil. This Action Memorandum describes the relevant site conditions and history and components of the removal action, and presents the rationale for selecting this alternative.

The objective of this action is to complete test pit activities in 14 locations areas previously identified to contain buried drums and miscellaneous containers, and remove all containers and metal debris and heavily contaminated soil potentially encountered. In addition, soil samples will be collected at the test pit locations to identify and characterize remaining soils which may require future remediation

2.0 SITE CONDITIONS

The NCP states that a removal action may be conducted at a site where a threat to human health or welfare or the environment is identified. An appropriate removal action is taken to abate, minimize, stabilize, mitigate, or eliminate the release or threat of release at a site. The following subsections describe NAS Brunswick and the conditions at Site 11 that support the need for a removal action.

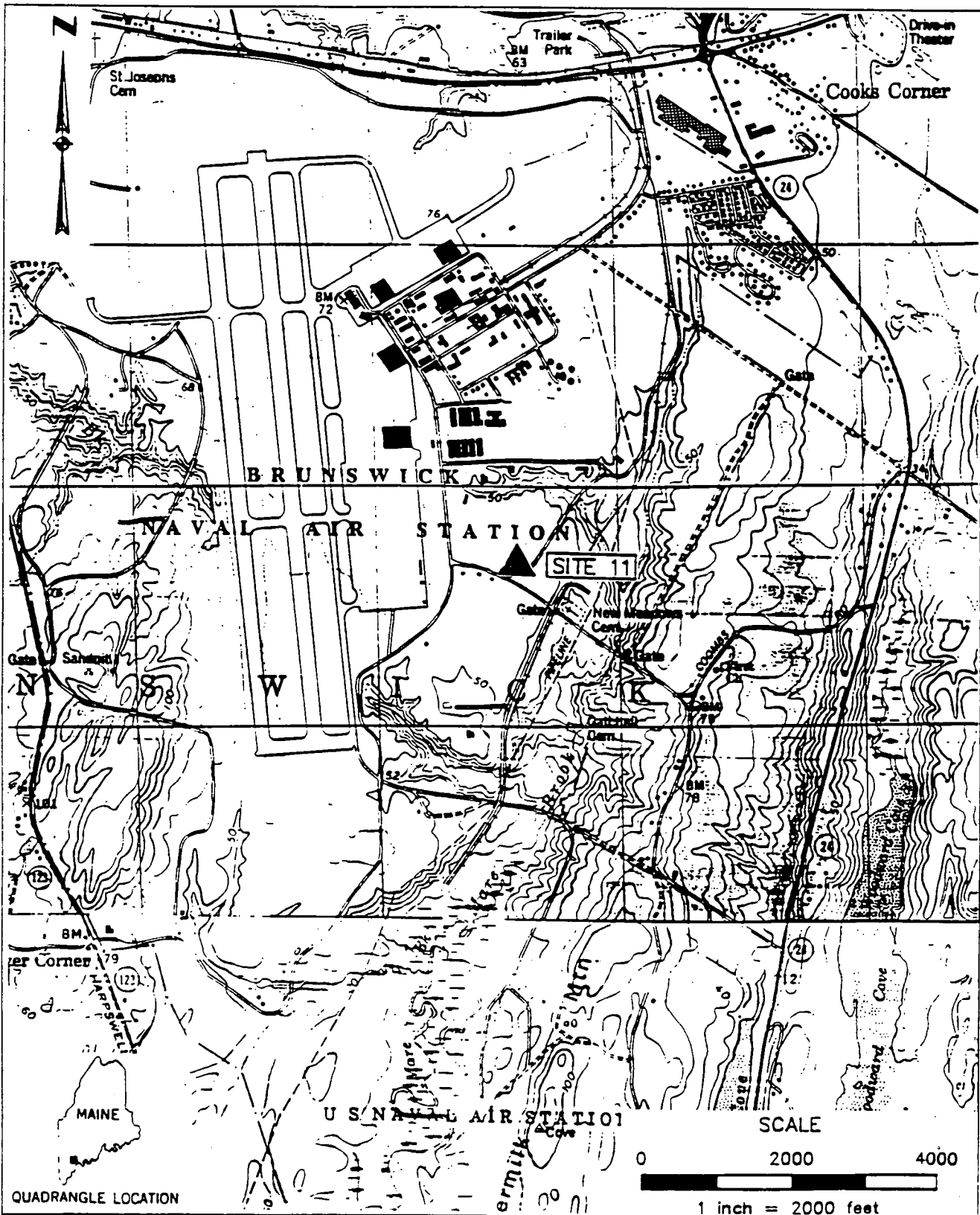
2.1 SITE DESCRIPTION


2.1.1 Removal Site Evaluation

NAS Brunswick, located south of the Androscoggin River between Brunswick and Bath, Maine (Figure 2-1), is an active base, owned and operated by the federal government through the Department of the Navy. The facility currently participates in the Navy's Installation Restoration Program (IRP). In 1987, the USEPA placed NAS Brunswick on the National Priorities List (NPL).

In 1989, Site 11 (FTA) was added to the Installation Restoration Program list of sites scheduled for Phase I Remedial Investigations (RI) that were being conducted on base. Previous site-characterization work had not been conducted at this site. Therefore, to characterize subsurface conditions, and to identify potential contamination at the site, explorations were conducted during the 1989 RI Field Program. These included a soil gas survey, five hand-auger borings, four test borings that were converted into monitoring wells, soil and groundwater sampling, and soil permeability testing. The soil gas survey indicated elevated volatile organic compound (VOC) concentrations in soil gas in the area immediately surrounding the fire pit. Samples collected from adjacent borings and monitoring wells also indicated the presence of VOCs in subsurface soils and groundwater. Detailed results of these explorations are discussed in the RI Report (E.C. Jordan Co., 1990).

To better characterize and delineate contaminants at the site, additional testing was conducted during 1990. Explorations conducted at this time included installing piezometers and monitoring wells, performing a cone penetrometer and groundwater screening program, installing test borings, digging eight test pits, sampling soils and groundwater, and testing soil permeability. The results of these investigations further delineated the presence of VOCs, semi-volatile organic compounds (SVOCs), and metals in the subsurface soils and groundwater. The results of these activities are presented in the Supplemental RI Report (E.C. Jordan Co., 1991).



SITE LOCATION MAP SITE 11-NAS-BRUNSWICK, MAINE		FIGURE 2-1  Halliburton NUS CORPORATION 187 Ballardvale St. Wilmington, MA 01887 (508) 658-7899	
DRAWN BY:	RJS	REV.:	0
CHECKED BY:	GHB	DATE:	AUGUST 1994
SCALE:	1" = 2000'	CONTRACT NO.:	N62472-90-D-1298/CTD-1511

Appendix A of this report contains two analytical data maps of soil and groundwater results that were prepared during the 1989 and 1990 field programs at the site. These data maps are an interpretive presentation of the laboratory analytical results; all organic chemical positive detection data are presented, and, as stated on the maps, metals detected in excess of eight times the contract-required detection limits are also reported. Complete analytical data are included in the appendices of the RI Report and the Supplemental RI Report (E.C. Jordan, 1990 and 1991).

Information obtained in 1993 by staff at the NAS Brunswick suggested, for the first time, that drums containing unknown liquids may have been buried at Site 11, the former Fire Training Area, sometime between 1970 and 1980 (ABB Environmental Services, Inc., January 1994). Based on this information, the Navy designed a program to locate and, if possible, sample drums for characterization. This program was designed to definitively establish the presence or absence of buried drums at this site and, if possible, provide limited analytical information on the contents of up to three drums. The Navy recognized that, if drums were found, they would need to be removed from the site as part of source remediation efforts. Field activities conducted for this site included magnetometer and ground penetrating radar (GPR) surveys followed by test pitting of the target areas identified during the geophysical surveys (ref. Appendix B: ABB Environmental Services, Inc. - Figure 4-1; "Vertical Magnetic Gradient Contours - Site 11). The results of these activities are presented in a technical memorandum prepared in January of 1994 (ABB Environmental Services, Inc., 1994). These investigative activities located buried drums and miscellaneous containers at five of fourteen test pit locations. Drums containing solvents and petroleum compounds were found to be in various stages of deterioration.

2.1.2 Physical Location

NAS Brunswick occupies approximately 3,099 acres. The NAS includes property identified as lot 0 (zero) on tax map 40 of the Town of Brunswick property maps. The site is owned by the United States of America, Department of the Navy, and is used by the Navy for military purposes.

The FTA is located near the intersection of Old Gurnet and Sandy Roads in the central portion of NAS Brunswick (Figure 2-1, Figure 2-2).

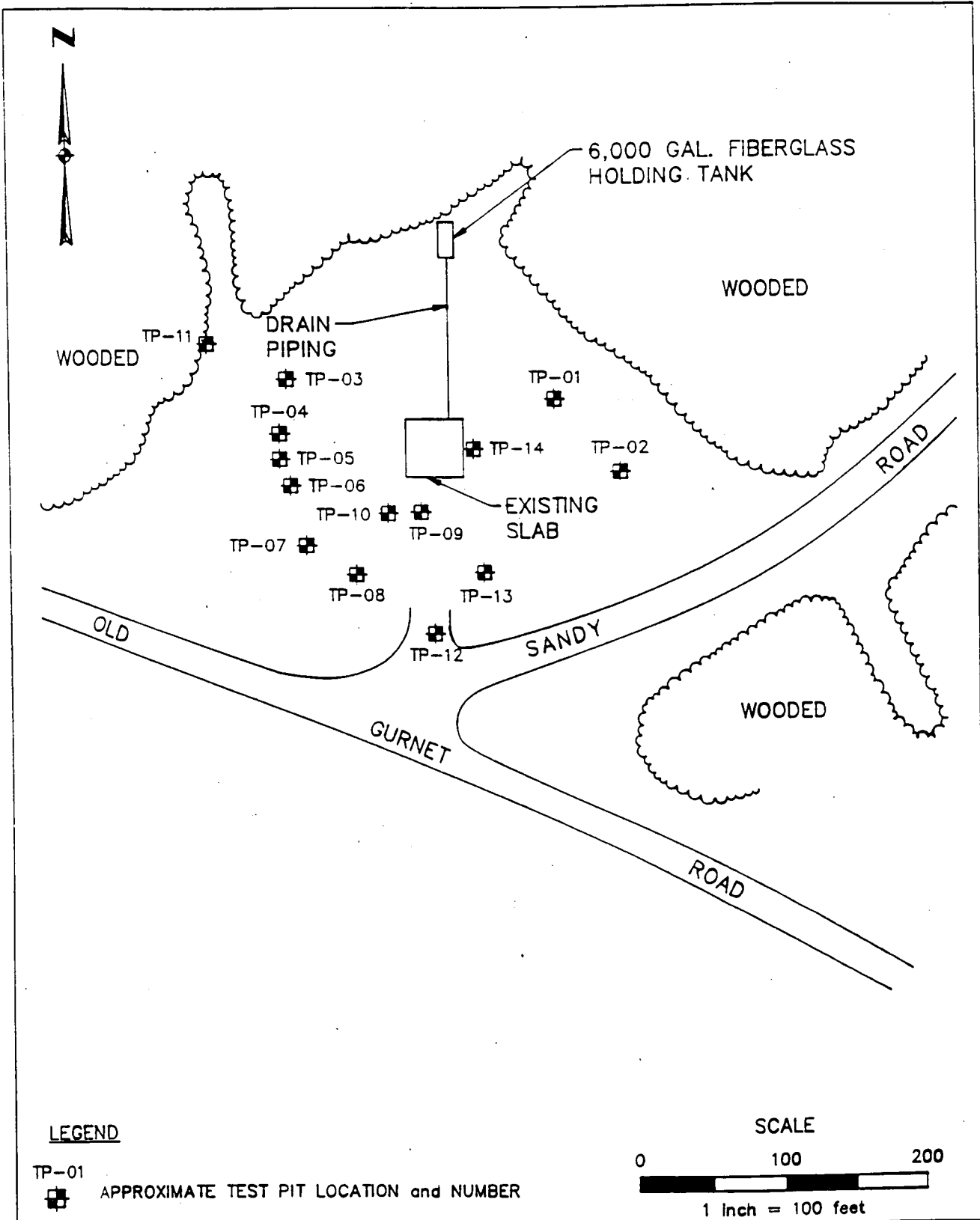
2.1.3 Site Characteristics

NAS Brunswick, located south of the Androscoggin River between Brunswick and Bath, Maine, is an active facility supporting the U.S. Department of the Navy's antisubmarine warfare operations in the Atlantic Ocean and Mediterranean Sea. Its primary mission is to operate and maintain P-3 Orion aircraft. NAS Brunswick first became active in the 1940s during World War II, and underwent major expansion in the 1950s.

The FTA reportedly has been used for training purposes since the 1950s, and probably since World War II. A 1959 aerial photograph shows a large blackened area at the current location of the FTA. Fire-fighting exercises at the FTA introduced various liquids into soils at the site, including waste oils, fuels, solvents, and other miscellaneous liquids. Multiple annual "burns" occurred during the 40-to-50-year time of use. Reportedly, the only measure taken before 1987 to control infiltration of the liquids into the soils was to saturate the ground surface with water to float the product prior to a burn. In 1987, the FTA was upgraded with the installation of a 40 feet x 40 feet concrete liner and berms. Additionally, a collection system, including piping and a 6,000-gallon fiberglass underground storage tank (UST), was installed north of the pit to contain unburned liquids.

The collection system includes two precast catch basins at the curb cuts with an 8-inch diameter drain pipe connecting these catch basins. A single 8-inch diameter underground drain pipe connects the eastern catch basin and the fiberglass holding tank situated approximately 100 feet to the north of the existing slab. A steel indicator valve that allows for opening and closing of the drain pipe leading to the tank is located above ground, approximately 20 feet south of the tank. The top of the fiberglass holding tank is specified to be located 2.5 feet below the existing grade, with the bottom of the tank extending to approximately 8 feet below ground surface. A 4-inch vent pipe and 2-foot diameter steel manhole extensions with a removable flat-ribbed top (for tank cleaning) extend from the tank to above the existing grade. No specifications have been found for the material used for the drain pipe.

According to historical records and interviews presented in the Technical Memorandum (ABB Environmental Services, Inc., 1994) most of the fuel used for fire-fighting exercises was JP-5 jet fuel or aviation gasoline (AVGAS). However, no quality control procedures were implemented for the materials that would eventually be used at the fire pit. According to NAS personnel, anything may have been brought to the site from any source on base if it was thought that the material might be flammable. Typically, barrels containing JP-5 obtained from the different squadrons on base would be brought to the site, temporarily stored, then rolled to the fire pit and emptied of their contents for the fire fighting exercises. The NAS Fire Chief recalled only one fire pit at the site and that the storage area for these drums was located west of the fire pit. Once emptied, the drums were typically brought to the Defense Reutilization and Marketing Office for disposal.



SITE MAP - SITE 11	
FIRE TRAINING AREA-NAS-BRUNSWICK, ME	
DRAWN BY: RJS	REV: 1
CHECKED BY: GHB	DATE: AUGUST 1994
SCALE: 1" = 100'	CONTRACT NO.: N62472-90-D-1298/CTD-1511



**Halliburton NUS
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2.1.4 Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

Sometime between 1970 to 1980, there reportedly was a one-time event of drums being buried in a trench of unknown dimensions. The exact location of the trench or the number or contents of the drums is unknown but estimates indicate that there were between 10 and 20 drums, and the general location was north of the pit and possibly into the woods west of the present location of the UST. It is unknown why the drums were buried, since any flammable liquids would presumably have been burned. The fact that some drums were buried may indicate that the contents were not flammable.

Chemical analysis of soil collected during the 1990 and 1991 RIs at the FTA detected the presence of several volatile and semi-volatile organic compounds. The 1993 magnetometer and GPR surveys of Site 11 identified a number of locations with anomalous geophysical signatures. Subsequent test-pitting activities uncovered drums in five separate locations. The condition of the drums was consistent with a reported disposal date of 10 to 20 years ago (ref Section 2.1.1). The amount of liquids or sludges remaining in these drums is unknown.

Due to the deteriorated condition of the drums and the need to minimize the possibility of rupturing them, most of them were left in the ground, although several were removed and temporarily stored above-ground at the site. It is not known how many additional drums may be present in these locations. TCLP analyses of samples from two drums indicated that one of the drums was nearly pure methyl ethyl ketone (MEK), an industrial solvent, and one was water contaminated with approximately 0.15% MEK. A third drum sample contained low levels of fuel-related compounds. Copies of the analytical reports for these samples are presented in Appendix C.

The potential for migration of contaminants released from leaking drums into subsurface soils and groundwater currently exists.

2.1.5 National Priorities List Status

In 1987, the USEPA placed NAS Brunswick on the NPL. In 1990, the Navy entered into an FFA with the USEPA and the MEDEP. The FFA sets forth the roles and responsibilities of each agency, sets deadlines for the investigation and cleanup of hazardous waste sites at NAS Brunswick, and establishes a mechanism to resolve disputes among the agencies.

The Navy's RCRA corrective action obligations relating to the release(s) of hazardous substances, hazardous wastes, pollutants, or contaminants at NAS Brunswick are also covered in the FFA. Therefore, all actions at the base must achieve compliance with CERCLA, 42 U.S.C. Section 9601 *et. seq.*; satisfy the corrective action requirements

of RCRA Sections 3004(u) and (v), 42 U.S.C. Sections 6924(u) and (v), for a RCRA permit, and RCRA Section 3008(h), 42 U.S.C. Section 6928(h), for interim status facilities; and meet or exceed all applicable or relevant and appropriate federal and state laws and regulations, to the extent required by CERCLA Section 121, 42 U.S.C. Section 9621 and applicable state laws.

The Navy has evaluated the contamination at Site 11 as part of the IRP and in accordance with the RCRA closure order signed by the Maine Board of Environmental Protection on May 22, 1991. A summary of other actions taken by the Navy as part of the IRP is included in the following paragraphs.

In 1983, an IAS was conducted at nine sites (Sites 1 through 9) at NAS Brunswick, which recommended further investigation at seven of these sites. In 1984, the Navy performed a Pollution Abatement Confirmation (PAC) Study, and, in 1987, conducted a Remedial Investigation/Feasibility Study (RI/FS) for the seven sites (Sites 1, 2, 3, 4, 7, 8, and 9) identified during the IAS and PAC studies. Based on further information, two sites, Sites 11 and 13, were added to the RI/FS program in 1989, and two additional sites, Sites 12 and 14, were included in 1990. Sites 5 and 6, initially identified in the IAS, were brought back into the Navy's IRP in 1989. A total of 13 sites are currently part of the RI/FS program, as follows:

- Site 1 Orion Street Landfill - North
- Site 2 Orion Street Landfill - South
- Site 3 Hazardous Waste Burial Area
- Site 4 Acid/Caustic Pit
- Site 5 Orion Street Asbestos Disposal Site
- Site 6 Sandy Road Rubble and Asbestos Disposal Site
- Site 7 Old Acid/Caustic Pit
- Site 8 Perimeter Road Disposal Site
- Site 9 Neptune Drive Disposal Site
- Site 11 Fire Training Area
- Site 12 Explosive Ordnance Dump Training Area
- Site 13 Defense Reutilization and Marketing Office
- Site 14 Old Dump No. 3

2.2 OTHER ACTIONS TO DATE

To date, no removal or remedial actions have been taken to abate, minimize, stabilize, or eliminate the release of contamination from the FTA site.

2.3

FEDERAL AND STATE AUTHORITIES ROLE

The Navy is undertaking this removal action pursuant to Executive Order 12580, the FFA, and CERCLA. Executive Order 12580 designates the Navy as the lead agency and gives it the authority to sign removal action memoranda. The FFA provides USEPA and the MEDEP with the opportunity to review and comment on the Navy's proposal to undertake removal actions.

The proposed removal action for Site 11 and corresponding documents will be reviewed by USEPA Region I, the MEDEP, and other members of the site Technical Review Committee (TRC) prior to implementation. To date, the USEPA has not taken any emergency response actions; no requests for USEPA assistance has been made at this site.

3.0 THREATS TO HUMAN HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

To date, relative to the buried drums, no ecological or human health risk studies have been performed at this site. Based on previous studies, however, it is assumed that existing surface and subsurface soil and groundwater contamination was caused by former fire training activities. The number, condition, and contents of buried drums is currently unknown. These drums may be a contributing source to the existing site contamination or, at a minimum, represent a potential source for future contamination.

3.1 HAZARDOUS SUBSTANCES, POLLUTANTS, OR CONTAMINANTS IN DRUMS, BARRELS, TANKS, OR OTHER BULK STORAGE CONTAINERS THAT MAY POSE A THREAT OF A RELEASE

Test pit investigations performed in 1993 revealed the presence of drums in five separate locations at the former FTA. The condition of the drums was consistent with a reported disposal date of 10 to 20 years ago. The volume of liquids or sludges remaining in these drums is unknown.

Due to the deteriorated condition of the drums and the need to minimize the possibility of rupturing them, most were left in the ground. However, several drums were removed and temporarily stored above-ground at the site. It is not known how many additional drums may be present in these locations. TCLP analyses of samples from two drums indicated that one of the drums was nearly pure methyl ethyl ketone (MEK), an industrial solvent, and one was water contaminated with approximately 0.15% MEK. A third drum sample contained low levels of fuel-related compounds.

Over time the drums will continue to deteriorate and potentially could release contaminants into the surrounding soils and groundwater.

4.0 ENDANGERMENT DETERMINATION

A time-critical removal action to facilitate the excavation and removal of drums has been identified for Site 11. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Action Memorandum, could present an imminent and substantial endangerment to public health, welfare, or the environment.

5.0 PROPOSED ACTIONS

The overall scope of work for this removal action is the excavation, removal, characterization, and disposal of buried drummed wastes and metallic debris. The objective of this action is to complete test pit activities in areas previously identified to contain buried drums and miscellaneous containers, and remove all containers and metal debris and grossly contaminated soil potentially encountered. As part of this action, an underground storage tank will also be removed.

Additionally, other abandoned drums have been recently discovered on the ground surface during construction activities along the site perimeter. Those drums will be managed similarly to the excavated drums. That is, these drums will be repackaged, if necessary, transported to the drum storage area, sampled, characterized for disposal, and transported to an off-site disposal facility for final deposition.

5.1 TEST PIT ACTIVITIES

This overall task includes mobilization and demobilization of all crews, equipment, and materials necessary to perform the work including: excavation of up to fourteen test pits; removal and packaging of drums/containers encountered; removal of miscellaneous debris (wood, metal); removal of heavily contaminated soil; characterization of wastes; and restoration of the site.

5.1.1 Mobilization

All crews, equipment, and materials will be mobilized to the site including office/storage trailers, subcontractors, portable sanitary facilities, and waste storage containers. All site facilities will be established, including the decontamination pad and waste storage areas. All work areas will be delineated. All personnel will receive site-specific health and safety training in accordance with the attached Health and Safety Plan (see Appendix D).

5.1.2 Perform Test Pits

Test pits will be performed in 14 previously identified areas where geophysical and magnetic anomalies were observed (ref. Appendix B). The excavation will be advanced through the fill areas only and will be discontinued when virgin soils or groundwater is encountered. During excavation of the test pits, all drums, miscellaneous containers, and metallic debris encountered will be segregated, inventoried, and staged in a prepared, lined, bermed, waste storage area. If suitable, the bermed concrete fire pit may be used as the drum storage area.

Drummed wastes will be re-containerized into suitable Department of Transportation (DOT) 85-gallon overpack containers. If visual observation of a drum determines that its movement may cause the drum to rupture, the contents of the drum will be transferred to a new drum prior to staging. Test pit logs documenting the conditions encountered during advancement of the excavation will be maintained.

Metallic debris will be decontaminated at the excavation site using dry methods (i.e. broom swept, scraped, or brushed) to remove caked soil prior to transporting to the staging area. Metallic debris that is encountered in contaminated soils, as determined by field observation (i.e. PID screening, visually inspection, etc.) will be first decontaminated using dry methods at the excavation site, then transported to the decontamination area where the metal will be pressure washed, as necessary.

If field observations indicate the presence of contaminated soils during excavation of the drums, soils within one meter of the potential source (i.e., a leaking drum) will be removed. Contaminated soils will be staged in water-tight steel roll-off containers and covered. All other soils will be staged next to the excavation, to be used as backfill.

Excavation below the groundwater table will be performed only as necessary to remove drums or other containers observed in the bottom of the excavation. Dewatering of the test pit excavations is not anticipated. All excavations will be sloped or bench-cut such that shoring or bracing will not be required.

5.1.3 Soil Sampling

The objective of the soil sampling is 1) to identify and characterize remaining soils which may require future remediation; and 2) to characterize contaminated soils for disposal purposes.

Upon completion of each test pit area excavation, soil samples will be collected from the bottom of the excavation and analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) target compounds (see Appendix E), target analyte list (TAL) inorganic analytes (see Appendix F), polychlorinated biphenyls (PCBs), and pesticides. At least one sample will be collected from an area in the excavation selected through PID field screening methods (ref. Appendix D - Field Sampling Plan). A second sample will be collected from a random location within the excavation. The intent of the sample is to represent the general chemical nature of soils within the test pit area. The sample, although random, will be collected away from locations previously sampled. This sampling scheme will provide additional data as to the general profile of soil contamination at the site. Additional samples may be collected if after excavation of drums, elevated PID readings are observed in soils adjacent to the drum location.

Sample collection and laboratory analysis will be performed in accordance with USEPA Contract Laboratory Program (CLP) procedures and protocols, Naval Energy and Environmental Support Activity (NEESA) Level C QA/QC protocols, and the site Field Sampling Plan (see Appendix D).

After the final soil samples are collected, the sample locations will be located based on taped measurements from prominent site features and recorded on site drawings. The test pit will then be backfilled with clean soils previously excavated; test pit finishing will match the surrounding grade with clean gravel from off-site sources. Mechanical compaction of backfill soils will not be performed.

5.2 CONFIRMATORY MAGNETOMETER SURVEY

Pending completion of the test pit excavation, drum and soil removal, and backfill activities, HNUS will perform a confirmatory magnetometer survey of the 14 test pit sites. The survey will be performed by establishing a 10-by-10-foot grid over the 14 test pit sites and obtaining magnetometer measurements at all grid points. An EDA OmnoPlus Vertical Gradiometer will be used for this work.

If magnetic anomalies are encountered, test pit activities as discussed in Section 5.1 will resume in those specific areas until all anomalies are explored and characterized. Upon completion of the removal of wastes from these areas, a final magnetometer survey will be performed over these areas.

5.3 WASTE DISPOSAL

Representative samples will be collected from each drum and staged soil stockpiles and will be submitted for disposal characterization analysis. Upon receipt of the analysis, each drum will be labeled and prepared for off-site disposal. Disposal options for the wastes, including disposal through the Navy, will be reviewed. The review of disposal options will also include a review of the compliance status for selected disposal facilities. Based on a review of the analytical information and compliance status of disposal facilities, a disposal facility will be selected and the wastes will be scheduled for shipment. All wastes will be transported and disposed in accordance with applicable state and federal regulations.

5.4 UST CLOSURE

The 6,000 gallon fiberglass underground storage tank was installed in 1986 as a spill control holding tank for the concrete fire training pit. Excess water and unburned oil used during fire training exercises were drained to the tank and stored until removal and disposal of the wastes could be effected. The tank contains approximately 4,500 gallons of oily water. A copy of the analytical report is presented in Appendix G. The

tank will be removed in accordance with State of Maine regulations (Maine Regulations 006-096, Chapter 695).

According to record drawings, the tank anchor slab was located on top of the tank during construction. Consequently, the top of the tank will be unearthed to the level of the top of slab. All piping from the fire training pit to the tank will be drained to the tank. Drains at the fire training pit will be plugged to prevent future flow from the pit. All free liquids will be pumped from the tank.

The tank atmosphere will be continually monitored for oxygen and Lower Explosive Limit (LEL). If the tank atmosphere exhibits an LEL reading of greater than 10 percent, as measured at the bottom, middle of the tank diameter, and at the tank opening, the tank atmosphere will be inerted with 90 pounds of dry ice.

Once tank atmosphere LEL readings are below 10 percent, the tank manholes will be opened and the tank interior will be rinsed using a high pressure water wash. If necessary, manholes will be cut into the tank endwalls to facilitate additional access into the tank. Personnel entering the tank will proceed under the procedures and protocols for confined space entry. All residual wastes and rinse solutions will be removed. The tank interior will be wiped dry.

Once the tank has been cleaned, all piping will be removed from the tank to the fire training pit and cut into ten foot lengths. The tank anchor slab will be demolished and removed. The tank will then be removed from the excavation. The tank exterior will be cleaned of soil and transported to an approved disposal facility.

Six soil samples collected from locations along the excavation walls and base will be screened onsite utilizing headspace techniques in accordance with State of Maine guidance documents. If screening results indicate the presence of contamination, the soil samples will be submitted for laboratory analysis for VOCs, SVOCs, TAL metals, PCBs, and pesticides. Laboratory sample locations will be depicted on site drawings based on taped measurements from prominent site features.

Following sample collection, the tank excavation will be backfilled to grade with clean fill. No mechanical compaction of soils will be performed. The tank anchor slab will remain on-site.

5.5 CONTRIBUTION TO REMEDIAL PERFORMANCE

The removal of drums containing hazardous materials and contaminated soil at this site would mitigate the potential risks to ecological receptors posed by various contaminants previously discovered. Based upon available information, the removal action would not hinder any other action that could be required as part of the long-term remedy for the site. Further, the information collected from contaminated soil


locations will assist in the development of strategies for future long-term remedial actions.

5.6 PROJECT SCHEDULE

The proposed removal action would take approximately ten weeks to implement. This includes all activities associated with contracting, mobilizing, excavating of test pits, performing the magnetometer survey, and closing the UST.

Disposal of wastes generated during the removal activities will be accomplished pending completion of the removal activities, receipt of waste characterization, and acceptance of the wastes at an approved, licensed disposal facility.

The foregoing represents the selection of the removal action by the Department of the Navy. Concur and Recommend for immediate implementation:

By: 
D. J. Nelson

Date: 26 Oct 94

Title: Captain, U.S. Navy
Commanding Officer
Naval Air Station
Brunswick, Maine

REFERENCES

REFERENCES

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing Materials
AVGAS	aviation gasoline
CERCLA	Comprehensive Environmental response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CSHM	CLEAN Health and Safety Manager
CTO	Contract Task Order
DOT	Department of Transportation
FFA	Federal Facility Agreement
FID	flame ionization detector
FSP	field sampling plan
FTA	Fire Training Area
GPR	ground-penetrating radar
HASP	health and safety plan
HSO	Health and Safety Officer
IDW	investigation derived waste
LEL	lower explosive limit
MEK	methyl ethyl ketone
MEDEP	Maine Department of Environmental Protection
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
PPM	part per million
RAS	routine analytical services

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SCBA	self-contained breathing apparatus
SOP	Standard Operating Procedure
SSO	Site Safety Officer
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
µg/L	micrograms per liter

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing Materials
AVGAS	aviation gasoline
CERCLA	Comprehensive Environmental response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CSHM	CLEAN Health and Safety Manager
CTO	Contract Task Order
DOT	Department of Transportation
FFA	Federal Facility Agreement
FID	flame ionization detector
FSP	field sampling plan
FTA	Fire Training Area
GPR	ground-penetrating radar
HASP	health and safety plan
HSO	Health and Safety Officer
IDW	investigation derived waste
LEL	lower explosive limit
MEK	methyl ethyl ketone
MEDEP	Maine Department of Environmental Protection
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
PPM	part per million
RCRA	Resource Conservation and Recovery Act

RI	Remedial Investigation
SCBA	self-contained breathing apparatus
SOP	Standard Operating Procedure
SSO	Site Safety Officer
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
μg/L	micrograms per liter

APPENDIX A

ANALYTICAL DATA - SEPTEMBER 1990 FEASIBILITY STUDY



583,500

HA-1102	Z	E
1,1-DICHLOROETHANE	7	0
1,2-DICHLOROETHANE (TOTAL)	22	38
1,1,1-TRICHLOROETHANE	8600	3800
TRICHLOROETHENE	11000	38
2-METHANONE	8700	-
TETRACHLOROETHENE	0	-
TOLUENE	34	0
ETHYLBENZENE	1300	0
XYLENE (TOTAL)	11000	68
BUTYLBENZYLPHthalate	3800	-
BIS(2-ETHYLBENZYLPHthalate	5300	-
LEAD	68.7	-

TP-1104	1'	Z	E
BARIUM	412	-	-
CHROMIUM	212.2	-	-
COPPER	127.2	-	-
IRON	28308	-	-
MAGNESIUM	18708	-	-
MANGANESE	889.2	-	-
POTASSIUM	18800	-	-
VANADIUM	123	-	-
ZINC	88.7	-	-

TP-1108	1' DUMP	Z	E
FLUORANTHENE	870 J	-	-
BIS(2-ETHYLBENZYLPHthalate	8800/8400	-	-
BENZOF(FLUORANTHENE	848 J	-	-
BENZOF(FLUORANTHENE	848 J	-	-
APICLOR-1254	1800 C.B. 1700 J	-	-
BARIUM	40034.2	-	-
CHROMIUM	63.4 391.8 J	-	-
COPPER	107 377 J	-	-
IRON	27900/23200	7810	1970
LEAD	128/282	-	-
VANADIUM	100/85.8	-	-
ZINC	124 3223 J	-	-

TP-1107	1' DUMP	Z	E
TRICHLOROETHENE	8 J/18 J	-	-
4,4'-DCE	-/70	-	-

HA-1105	Z	E
TRICHLOROETHENE	11	-
CADMIUM	-	32.8
COPPER	-	121
LEAD	-	11.8
ZINC	-	88

BASE MAP PREPARED FROM PLANS COMPILED AND CONTROLLED BY JAMES S. SEWALL CO., OLD TOWN, MAINE, 26 SHEETS, DATED 11/12/81; AND FROM PLANS ENTITLED "U.S. NAVAL AIR STATION, BRUNSWICK, MAINE," 9 SHEETS, COMPILED IN JANUARY 1958; MODIFIED BY E.C. JORDAN CO. BASED ON FIELD OBSERVATIONS.

HA-1101	Z	E
TOTAL PAHs	ND	ND

MW-301

TP-1101	1'	Z	E
2-BUTANONE	-	21000 J	-
PHENANTHRENE	-	3800	-
PYRENE	-	3800	-
HEPTACLOR	-	68	-
ENDOSULFAN 8	-	34	-
LEAD	289.2	378 J	-

CP-154

TP-1103	1'	Z	E
1,1,1-TRICHLOROETHANE	13	-	-

HA-1103	Z	E
TOTAL PAHs	2300	-
LEAD	11.7	-

HA-1104	Z	E
TOTAL PAHs	800	-
LEAD	9.8	-

TP-1105	1'	Z	E
NO	-	-	-

MW-304	22' DUMP	34'	36'
NO	-	-	-

MW-1100	12' DUMP	Z	E
1,1,1-TRICHLOROETHANE	440	-	-
TRICHLOROETHENE	70	-	-

MW-1104	1'	Z	E
NO	-	-	-

TP-1108	1'	Z	E
NO	-	-	-

HA-1105	Z	E
TRICHLOROETHENE	11	-
CADMIUM	-	32.8
COPPER	-	121
LEAD	-	11.8
ZINC	-	88

LEGEND

- J ESTIMATED CONCENTRATION
D CONCENTRATION OBTAINED BY DILUTION
X LABORATORY-DEFINED QUALIFIER TO PROVIDE INFORMATION NOT PROVIDED BY OTHER QUALIFIERS
MW-301 MONITORING WELL LOCATION
TP-1101 TEST PIT LOCATION
CP-155 CONE PENETROMETER BORING LOCATION
P-102 PIEZOMETER LOCATION
HA-1103 HAND-AUGER SAMPLE LOCATION

NOTES:

1. ORGANIC DATA REPORTED IN ug/kg.
2. SAMPLES COLLECTED IN SEPTEMBER 1990.
3. INORGANIC DATA REPORTED IN mg/kg. INORGANICS IN EXCESS OF EIGHT TIMES THE CONTRACT-REQUIRED QUANTITATION LIMIT ARE PRESENTED.
4. GROUNDWATER IS APPROXIMATELY 10 TO 15 FEET BELOW GROUND SURFACE.

Drawn By: Date: 4/91
Checked By: Date: 4/91

EC JORDAN CO.
CONSULTING ENGINEERS

INSTALLATION RESTORATION PROGRAM
NAVAL AIR STATION
BRUNSWICK, MAINE

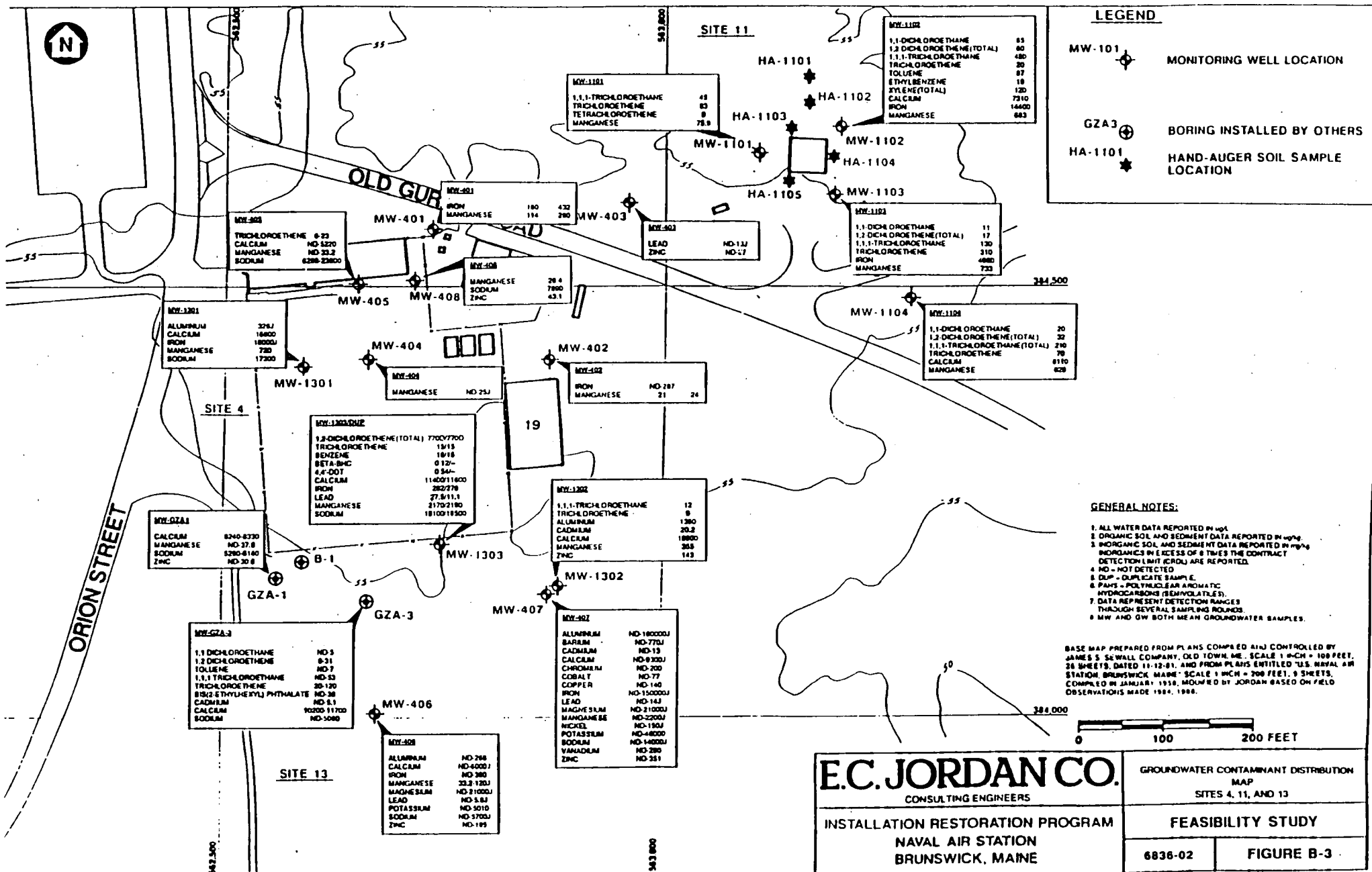
INTERPRETIVE
SOIL ANALYTICAL DATA MAP
SITE 11

FEASIBILITY STUDY

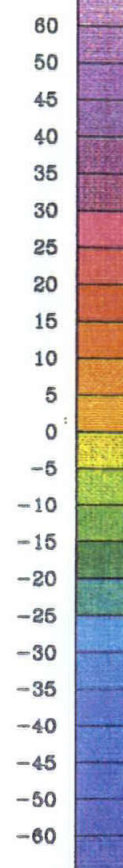
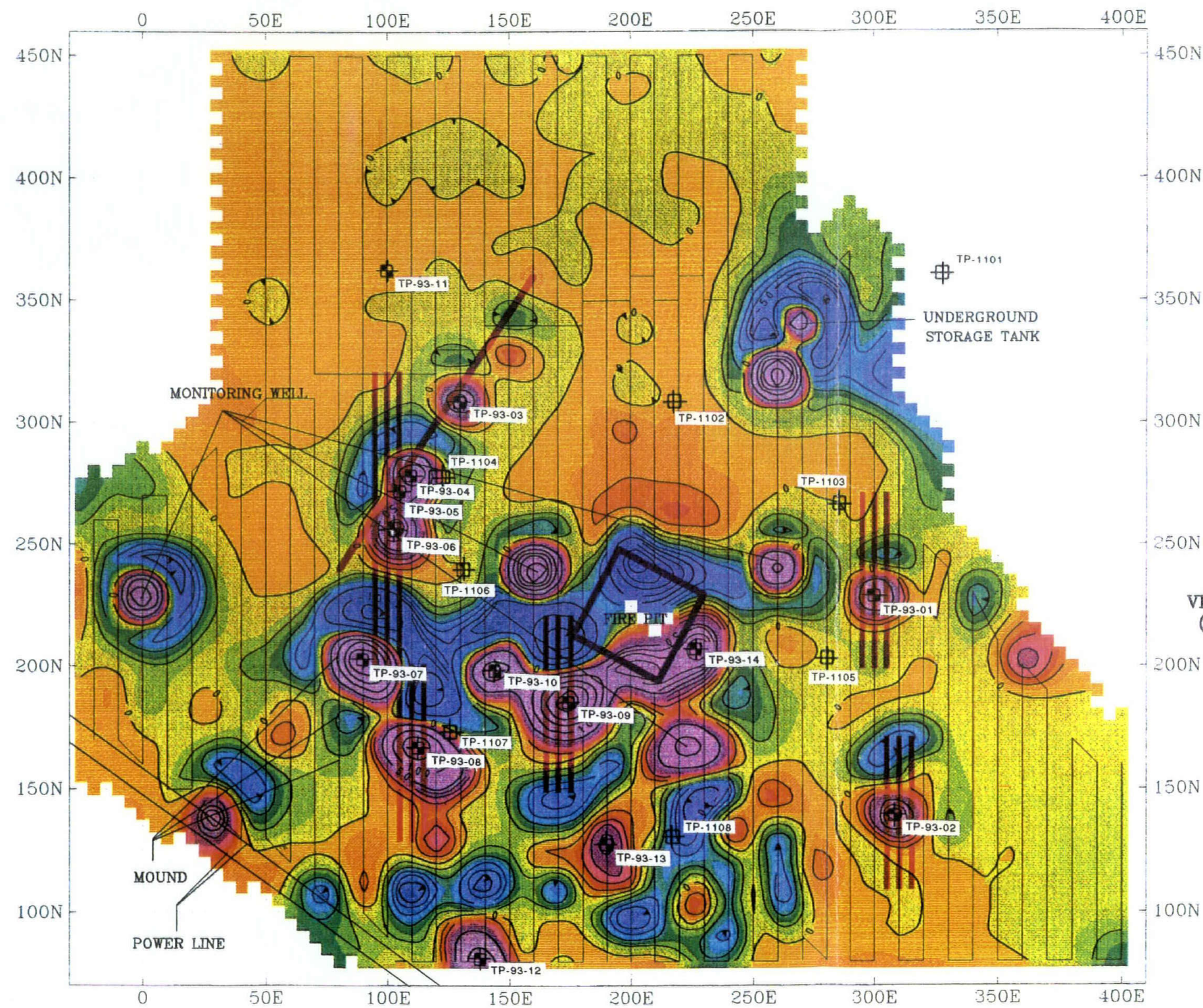
4607-56

FIGURE 4-2

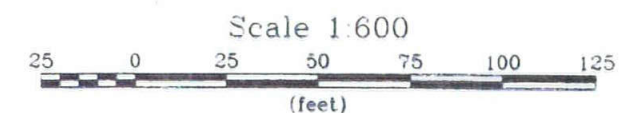
SCALE IN FEET
0 100 200



APPENDIX B
MAGNETIC GRADIENT CONTOUR FIGURE



VERTICAL GRADIENT
(GAMMAS/METER)







-  GPR TRAVERSE
-  MAGNETOMETER TRAVERSE
-  APPROXIMATE TEST PIT LOCATION
(14 NEW LOCATIONS)
-  APPROXIMATE TEST PIT LOCATION
(8 EXISTING LOCATIONS)

ABB ABB Environmental Services, Inc. <small>ASEA BROWN BOVERI</small>	VERTICAL MAGNETIC GRADIENT CONTOURS - SITE 11 (FIRE TRAINING AREA)	
	RI/FS PROGRAM INSTALLATION RESTORATION PROGRAM NAVAL AIR STATION BRUNSWICK, MAINE	FIGURE 4-1 JOB NO. 7131-02

APPENDIX C
DRUM SAMPLE DATA

TP-93-01

NET Atlantic, Cambridge Division

ANALYTICAL REPORT

Report Date: 10/28/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BMAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-01

NET Sample No: 87598

Parameter	ug/L	Date Analyzed	MCL ug/L

Volatiles by GC/MS-TCLP	S		
TCLP Zero Headspace Extraction		09/22/1993	
Benzene	26	09/26/1993	500
Carbon Tetrachloride	<25	09/26/1993	500
Chlorobenzene	<25	09/26/1993	100000
Chloroform	<25	09/26/1993	6000
1,2-Dichloroethane	<25	09/26/1993	500
Methyl Ethyl Ketone	<100	09/26/1993	200000
1,1-Dichloroethene	<25	09/26/1993	700
Tetrachloroethene	<25	09/26/1993	700
Trichloroethene	<25	09/26/1993	500
Vinyl Chloride	<100	09/26/1993	200

MCL = Maximum Contaminant Level

Results are uncorrected for matrix effects

30009

NET Cambridge Division ANALYTICAL REPORT

Report Date: 10/28/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-01

NET Sample No: 87598

Parameter	Result	Units	Analysis Date	Analyst

TCL Acid/Base/Neutrals 8270 AQ				
Acenaphthene	10000	ug/L	10/04/1993	jcg
Acenaphthylene	<10000	ug/L		
Anthracene	<10000	ug/L		
Benzo(a)Anthracene	<10000	ug/L		
Benzo(a)Pyrene	<10000	ug/L		
Benzo(b)Fluoranthene	<10000	ug/L		
Benzo(g,h,i)Perylene	<10000	ug/L		
Benzo(k)Fluoranthene	<10000	ug/L		
Benzoic Acid	<10000	ug/L		
Benzyl Alcohol	<10000	ug/L		
4-Bromophenyl-phenylether	<10000	ug/L		
Butylbenzylphthalate	<10000	ug/L		
4-Chloro-3-Methylphenol	<10000	ug/L		
4-Chloroaniline	<10000	ug/L		
bis(2-Chloroethoxy)Methane	<10000	ug/L		
bis(2-Chloroethyl)Ether	<10000	ug/L		
bis(2-Chloroisopropyl)Ether	<10000	ug/L		
2-Chloronaphthalene	<10000	ug/L		
2-Chlorophenol	<10000	ug/L		
4-Chlorophenyl-phenylether	<10000	ug/L		
Chrysene	10000	ug/L		
Di-n-Butylphthalate	<10000	ug/L		
Di-n-Octyl Phthalate	<10000	ug/L		
Dibenz(a,h)Anthracene	<10000	ug/L		
Dibenzofuran	10000	ug/L		
1,2-Dichlorobenzene	<10000	ug/L		
1,3-Dichlorobenzene	<10000	ug/L		
1,4-Dichlorobenzene	<10000	ug/L		
3,3'-Dichlorobenzidine	<10000	ug/L		
2,4-Dichlorophenol	<10000	ug/L		
Diethylphthalate	<10000	ug/L		
Dimethyl Phthalate	<10000	ug/L		
2,4-Dimethylphenol	<10000	ug/L		
4,6-Dinitro-2-Methylphenol	<10000	ug/L		
2,4-Dinitrophenol	<10000	ug/L		
2,4-Dinitrotoluene	<10000	ug/L		
2,6-Dinitrotoluene	<10000	ug/L		
bis(2-Ethylhexyl)Phthalate	<10000	ug/L		
Fluoranthene	<10000	ug/L		
Fluorene	<10000	ug/L		
Hexachlorobenzene	<10000	ug/L		
Hexachlorobutadiene	<10000	ug/L		
Hexachlorocyclopentadiene	<10000	ug/L		
Hexachloroethane	<10000	ug/L		
Indeno(1,2,3-cd)Pyrene	<10000	ug/L		
Isophorone	<10000	ug/L		
2-Methylnaphthalene	430000	ug/L		

40009

NET Cambridge Division

ANALYTICAL REPORT

Report Date: 10/22/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-01

NET Sample No: 87598

Parameter	Result	Units	Analysis Date	Analyst
2-Methylphenol	<10000	ug/L	10/04/1993	jcg
4-Methylphenol	<10000	ug/L		
N-Nitroso-di-n-Propylamine	<10000	ug/L		
N-Nitrosodimethylamine	<10000	ug/L		
N-Nitrosodiphenylamine	20000	ug/L		
Naphthalene	100000	ug/L		
2-Nitroaniline	<10000	ug/L		
3-Nitroaniline	<10000	ug/L		
4-Nitroaniline	<10000	ug/L		
Nitrobenzene	<10000	ug/L		
2-Nitrophenol	<10000	ug/L		
4-Nitrophenol	<10000	ug/L		
Pentachlorophenol	<10000	ug/L		
Phenanthrene	99000	ug/L		
Phenol	<10000	ug/L		
Pyrene	10000	ug/L		
1,2,4-Trichlorobenzene	<10000	ug/L		
2,4,5-Trichlorophenol	<10000	ug/L		
2,4,6-Trichlorophenol	<10000	ug/L		

NET Atlantic, Cambridge Division

ANALYTICAL REPORT

Report Date: 10/19/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-0T

NET Sample No: 87598

Parameter		mg/L	Date Analyzed	MCL mg/L

Metals - TCLP	S			
TCLP-EXTRACTION-ORG & METALS			09/27/1993	
TCLP Digestion-Metals			10/06/1993	
Arsenic (As)	TCLP 846 ICP S	<1.0	10/08/1993	5.0
Barium (Ba)	TCLP 846 ICP S	2.5	10/08/1993	100
Cadmium (Cd)	TCLP 846 ICP S	<0.25	10/08/1993	1.0
Chromium (Cr)	TCLP 846 ICP S	1.3	10/08/1993	5.0
Lead (Pb)	TCLP 846 ICP S	15	10/08/1993	5.0
Mercury (Hg)	TCLP 846 CVAA S	<0.020	10/05/1993	0.2
Selenium (Se)	TCLP 846 ICP S	<2.0	10/08/1993	1.0
Silver (Ag)	TCLP 846 ICP S	<0.25	10/08/1993	5.0

MCL = Maximum Contaminant Level

Results are uncorrected for matrix effects

NET Cambridge Division

ANALYTICAL REPORT

Report Date: 10/19/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-01

NET Sample No: 87598

Parameter			Result	Units	Analysis Date	Analyst
Corrosivity	SW846	S	6.69	pH units	09/14/1993	jmt
Cyanide, Reactive, SW846		S	<2.5	mg/Kg	09/17/1993	lmz
Ignitability		S	Ignitable		09/30/1993	lmz
Sulfide, Reactive, SW846		S	<250	mg/Kg	09/15/1993	pas

NET Cambridge Division ANALYTICAL REPORT

Report Date: 11/02/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-01

NET Sample No: 87598

Parameter	Result	Units	Analysis Date	Analyst
Pesticides	TCLP			
Chlordane	<10	ug/L	10/18/1993	ner
Endrin	<0.2	ug/L		
Heptachlor and its epoxide	<0.2	ug/L		
gamma-BHC (Lindane)	<0.1	ug/L		
Methoxychlor	<1.0	ug/L		
Toxaphene	<10	ug/L		

TP-93-03

NET Atlantic, Cambridge Division

ANALYTICAL REPORT

Report Date: 10/28/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter	ug/L	Date Analyzed	MCL ug/L

Volatiles by GC/MS-TCLP	S		
TCLP Zero Headspace Extraction		09/22/1993	
Benzene	<25000000	09/26/1993	500
Carbon Tetrachloride	<25000000	09/26/1993	500
Chlorobenzene	<25000000	09/26/1993	100000
Chloroform	<25000000	09/26/1993	6000
1,2-Dichloroethane	<25000000	09/26/1993	500
Methyl Ethyl Ketone	* 110%	09/26/1993	200000
1,1-Dichloroethene	<25000000	09/26/1993	700
Tetrachloroethene	<25000000	09/26/1993	700
Trichloroethene	<25000000	09/26/1993	500
Vinyl Chloride	<100000000	09/26/1993	200

* Due to the pure nature of this sample the calculated concentration was reported in percent level.

MCL = Maximum Contaminant Level

Results are uncorrected for matrix effects

30014

NET Cambridge Division

ANALYTICAL REPORT

Report Date: 10/22/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter	Result	Units	Analysis Date	Analyst

TCL Acid/Base/Neutrals 8270 AQ				
Acenaphthene	<1000	ug/L	10/04/1993	jcg
Acenaphthylene	<1000	ug/L		
Anthracene	<1000	ug/L		
Benzo(a)Anthracene	<1000	ug/L		
Benzo(a)Pyrene	<1000	ug/L		
Benzo(b)Fluoranthene	<1000	ug/L		
Benzo(g,h,i)Perylene	<1000	ug/L		
Benzo(k)Fluoranthene	<1000	ug/L		
Benzoic Acid	<1000	ug/L		
Benzyl Alcohol	<1000	ug/L		
4-Bromophenyl-phenylether	<1000	ug/L		
Butylbenzylphthalate	<1000	ug/L		
4-Chloro-3-Methylphenol	<1000	ug/L		
4-Chloroaniline	<1000	ug/L		
bis(2-Chloroethoxy)Methane	<1000	ug/L		
bis(2-Chloroethyl)Ether	<1000	ug/L		
bis(2-Chloroisopropyl)Ether	<1000	ug/L		
2-Chloronaphthalene	<1000	ug/L		
2-Chlorophenol	<1000	ug/L		
4-Chlorophenyl-phenylether	<1000	ug/L		
Chrysene	<1000	ug/L		
Di-n-Butylphthalate	<1000	ug/L		
Di-n-Octyl Phthalate	<1000	ug/L		
Dibenz(a,h)Anthracene	<1000	ug/L		
Dibenzofuran	<1000	ug/L		
1,2-Dichlorobenzene	<1000	ug/L		
1,3-Dichlorobenzene	<1000	ug/L		
1,4-Dichlorobenzene	<1000	ug/L		
3,3'-Dichlorobenzidine	<1000	ug/L		
2,4-Dichlorophenol	<1000	ug/L		
Diethylphthalate	<1000	ug/L		
Dimethyl Phthalate	<1000	ug/L		
2,4-Dimethylphenol	<1000	ug/L		
4,6-Dinitro-2-Methylphenol	<1000	ug/L		
2,4-Dinitrophenol	<1000	ug/L		
2,4-Dinitrotoluene	<1000	ug/L		
2,6-Dinitrotoluene	<1000	ug/L		
bis(2-Ethylhexyl)Phthalate	1000	ug/L		
Fluoranthene	<1000	ug/L		
Fluorene	<1000	ug/L		
Hexachlorobenzene	<1000	ug/L		
Hexachlorobutadiene	<1000	ug/L		
Hexachlorocyclopentadiene	<1000	ug/L		
Hexachloroethane	<1000	ug/L		
Indeno(1,2,3-cd)Pyrene	<1000	ug/L		
Isophorone	<1000	ug/L		
2-Methylnaphthalene	<1000	ug/L		

40028

NET Cambridge Division ANALYTICAL REPORT

Report Date: 10/22/1993

Report To: ABB Environmental, Inc.

Project: BMAS Site 11 Fieldwork

NET Job No: 93.03071

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter	Result	Units	Analysis Date	Analyst
2-Methylphenol	<1000	ug/L	09/29/1993	jcg
4-Methylphenol	<1000	ug/L		
N-Nitroso-di-n-Propylamine	<1000	ug/L		
N-Nitrosodimethylamine	<1000	ug/L		
N-Nitrosodiphenylamine	<1000	ug/L		
Naphthalene	<1000	ug/L		
2-Nitroaniline	<1000	ug/L		
3-Nitroaniline	<1000	ug/L		
4-Nitroaniline	<1000	ug/L		
Nitrobenzene	<1000	ug/L		
2-Nitrophenol	<1000	ug/L		
4-Nitrophenol	<1000	ug/L		
Pentachlorophenol	<1000	ug/L		
Phenanthrene	<1000	ug/L		
Phenol	<1000	ug/L		
Pyrene	<1000	ug/L		
1,2,4-Trichlorobenzene	<1000	ug/L		
2,4,5-Trichlorophenol	<1000	ug/L		
2,4,6-Trichlorophenol	<1000	ug/L		

NET Atlantic, Cambridge Division

ANALYTICAL REPORT

Report Date: 10/19/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter		mg/L	Date Analyzed	MCL mg/L
Metals - TCLP	S			
TCLP-EXTRACTION-ORG & METALS			09/27/1993	
TCLP Digestion-Metals			09/28/1993	
Arsenic (As)	TCLP 846 ICP S	<1.0	09/30/1993	5.0
Barium (Ba)	TCLP 846 ICP S	<1.0	09/29/1993	100
Cadmium (Cd)	TCLP 846 ICP S	<0.25	09/29/1993	1.0
Chromium (Cr)	TCLP 846 ICP S	<0.25	09/29/1993	5.0
Lead (Pb)	TCLP 846 ICP S	<1.0	09/29/1993	5.0
Mercury (Hg)	TCLP 846 CVAA S	<0.020	10/05/1993	0.2
Selenium (Se)	TCLP 846 ICP S	<2.0	09/29/1993	1.0
Silver (Ag)	TCLP 846 ICP S	<0.25	09/29/1993	5.0

MCL = Maximum Contaminant Level

Results are uncorrected for matrix effects

NET Cambridge Division ANALYTICAL REPORT

Report Date: 10/19/1993

Report To: ABB Environmental, Inc.

NET Job No: 93.03071

Project: BNAS Site 11 Fieldwork

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter		Result	Units	Analysis Date	Analyst
Cyanide, Reactive, SW846	S	<2.5	mg/Kg	09/17/1993	lmz
Ignitability	S	Ignitable		10/05/1993	jmt
Sulfide, Reactive, SW846	S	8400	mg/Kg	09/15/1993	pas

NET Cambridge Division

ANALYTICAL REPORT

Report Date: 11/02/1993

Report To: ABB Environmental, Inc.

Project: BNAS Site 11 Fieldwork

NET Job No: 93.03071

Date Rec'd: 09/10/1993

Sample ID: TP-93-03

NET Sample No: 87599

Parameter	Result	Units	Analysis Date	Analyst
Pesticides	TCLP			
Chlordane	<5.0	ug/L	10/18/1993	ner
Endrin	<0.1	ug/L		
Heptachlor and its epoxide	0.01	J ug/L		
gamma-BHC (Lindane)	0.02	J ug/L		
Methoxychlor	<0.5	ug/L		
Toxaphene	<5.0	ug/L		

APPENDIX D
FIELD SAMPLING PLAN

**Field Sampling Plan
for the
Site 11 - Fire Training Area (FTA)
Naval Air Station
Brunswick, Maine**



**Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 121**

October 1994

FIELD SAMPLING PLAN
FOR THE
SITE 11 - FIRE TRAINING AREA (FTA)
NAVAL AIR STATION
BRUNSWICK, MAINE

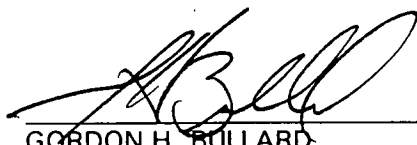
Submitted to:
Northern Division
Environmental Branch, Code 18
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
Halliburton NUS Corporation
993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087

CONTRACT NUMBER N62472-90-D-1298
"CLEAN" Contract Task Order No. 121

October 1994

SUBMITTED FOR HALLIBURTON NUS BY:


GORDON H. BULLARD
PROJECT MANAGER
HALLIBURTON NUS CORPORATION
WILMINGTON, MASSACHUSETTS

APPROVED BY:

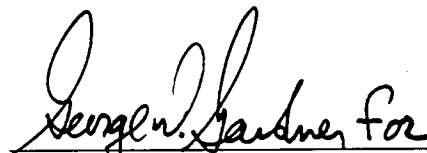

JOHN TREPANOWSKI
PROGRAM MANAGER
HALLIBURTON NUS CORPORATION
WAYNE, PENNSYLVANIA

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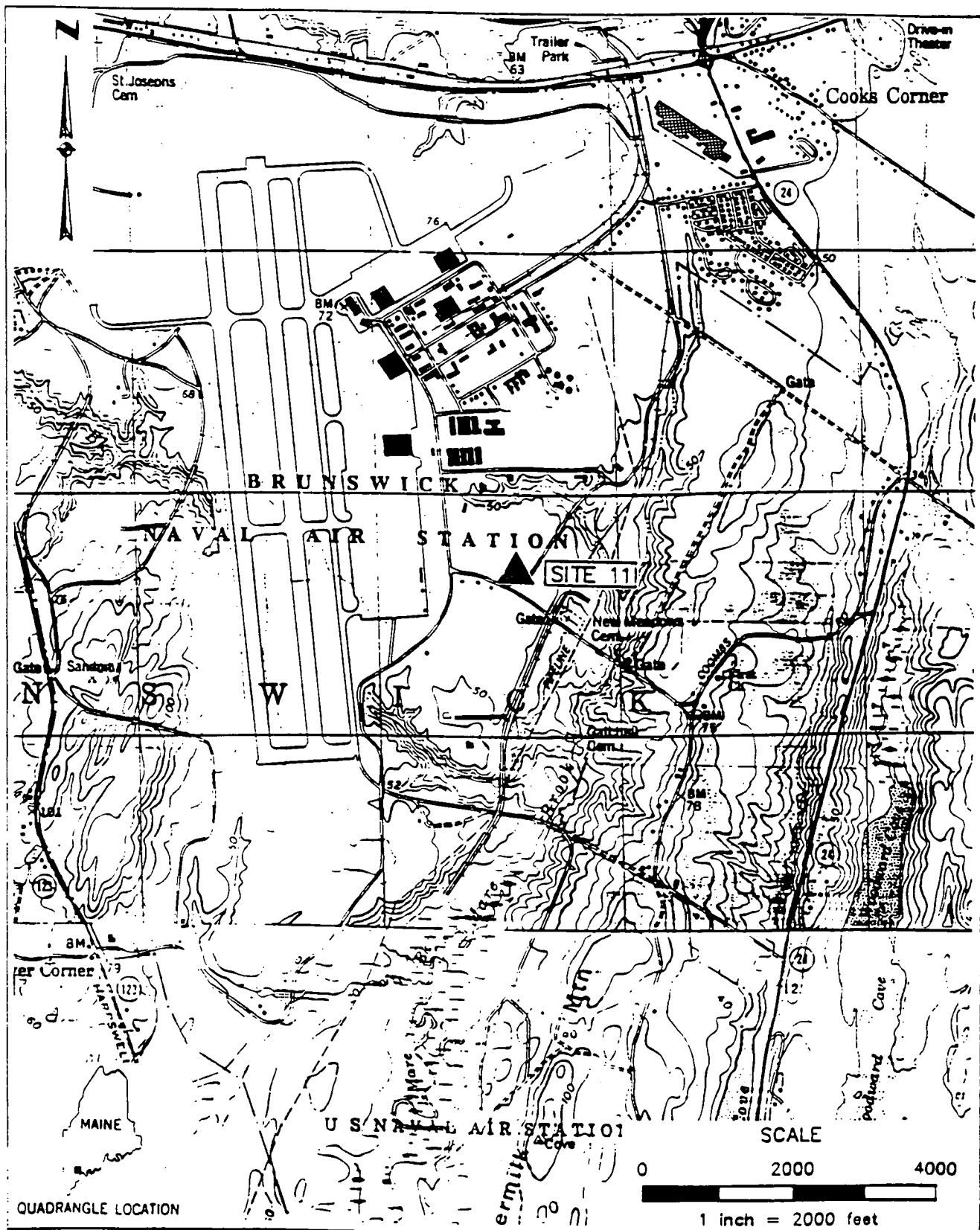
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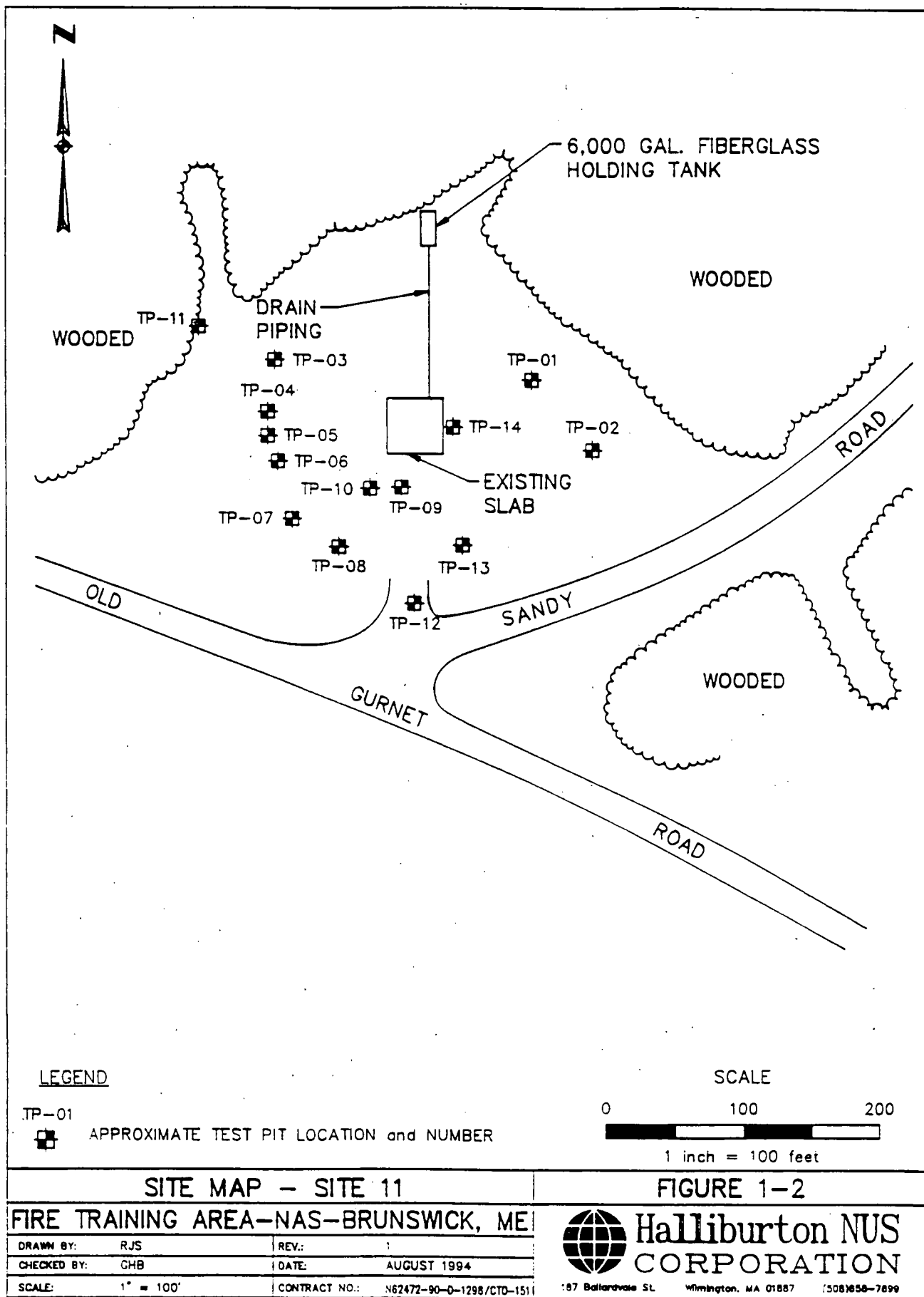
1.0 INTRODUCTION

This document is the Field Sampling Plan (FSP) for Contract Task Order (CTO) 151, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298. This FSP presents the fieldwork activities to be conducted by Halliburton NUS Corporation (Halliburton NUS) as part of the Removal Action/ Disposal work at the Naval Air Station's former Fire Training Area (FTA) - Site 11 located in Brunswick, Maine (Figure 1-1 and Figure 1-2). The activities in support of the tasks presented in this FSP are discussed and managed under the Action Memorandum document prepared for this site.

Up to fourteen test pits will be excavated on the FTA property at locations where drums may be buried. Pursuant to the scope of work, Halliburton NUS will collect a minimum of two soil samples from the bottom of each test pit. Additionally, an underground storage tank (UST) will be excavated and removed and six soil samples will be collected from the walls and bottom of the excavation. The sampling program presented in this Field Sampling Plan (FSP) focuses on characterizing potential soil contamination in the subsurface soils. Deviations from this FSP must be approved by the Halliburton NUS Project Manager.



SITE LOCATION MAP		FIGURE 1-1	
SITE 11-NAS-BRUNSWICK, MAINE		Halliburton NUS CORPORATION	
DRAWN BY: PJS	REV: 0		187 Ballardvale St. Wilmington, MA 01887 (508) 658-7899
CHECKED BY: CHB	DATE: AUGUST 1994		
SCALE: 1" = 2000'	CONTRACT NO.: N62472-90-D-1298/CTO-151		



2.0 SAMPLING OBJECTIVES

Previous site investigations identified buried drums, containers, and miscellaneous metallic debris. The objectives of the soil sampling effort are 1) to identify and characterize remaining soils which may require future remediation; and 2) to characterize contaminated soils for disposal purposes. Soil samples will be collected from the excavations to support the objectives.

3.0 FIELD INVESTIGATION TASK DESCRIPTIONS

To accomplish the objectives discussed above, subsurface soil samples will be collected from the site for analysis. Summary tables of sample analyses; sample containers, preservatives, holding time requirements; and field quality controls for all the sampling activities are presented in Tables 3-1, 3-2, and 3-3, respectively, at the end of this section. All samples will be collected and analyses performed in accordance with EPA CLP Methods and NEESA Level C QA/QC protocols. Adequate sample volume for all analyses will be collected in a stainless steel bowl and then transferred into the appropriate sample bottles. All field activities will be conducted in accordance with health and safety procedures established in the Site Health and Safety Plan (HASP), which is presented as Attachment A of this FSP.

All crews, equipment, and materials will be mobilized to the site, including office/storage trailers, subcontractors, portable sanitary facilities, and waste storage containers. All site facilities will be established, including the decontamination pad and waste storage areas, and work areas will be delineated. Site-specific health and safety training will also be conducted as part of the field tasks.

The following sections detail the site-specific sampling procedures for each sampling task. All sampling data and applicable field observations will be recorded on the appropriate sample log sheets (Attachment B) or in the Site field logbook, to be maintained by the Field Team Leader (FTL) or designee.

3.1 TEST PIT SOIL SAMPLING

After each test pit is excavated, two soil samples will be collected from the bottom of the excavation. One soil sample will be collected from a selected area in the excavation, selected based on the highest concentration of contaminants as detected by PID sample headspace field screening methods and/or visible contamination. If elevated PID readings are detected, then a soil sample will be collected from the area where the highest reading was recorded.

A second sample will be collected from a random location within the excavation. The intent of the sample is to represent the general chemical nature of soils within the test pit area. The sample, although random, will be collected away from "hot spot" locations previously sampled. This sampling scheme will provide additional data as to the general profile of soil contamination at the site. Additional samples may be collected depending on the size of the excavation, observed conditions, or contaminant distribution.

Soil sample collection and laboratory analysis will be performed in accordance with EPA CLP and NEESA Level C QA/QC protocols and Halliburton NUS SOPs. The

samples will be analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and pesticides, and TAL metals. Samples collected for VOCs will be transferred directly into appropriate sample containers. All other sample aliquots including duplicates will be homogenized prior to placing into the respective sample containers (ref. SOP GH-1.3.).

After the final soil samples are collected, the sample locations will be located based on taped measurements from prominent site features and recorded on site drawings. The test pit will then be backfilled with soils previously excavated and finished to match the surrounding grade with clean fill from off-site sources.

3.2 UST SOIL SAMPLING

Six soil samples, one from each of four excavation walls and two from the bottom of the excavation, will be collected after the UST has been excavated and removed. Samples will be collected from selected areas using the same screening method (PID or visual), as discussed in Section 3.1. Soil sample collection and laboratory analysis will be performed in accordance with EPA CLP and NEESA Level C QA/QC protocols. The samples will be submitted for VOCs, SVOCs, PCBs and pesticides, total petroleum hydrocarbons (TPH), and TAL metals.

Following sample collection, the tank excavation will be backfilled to grade with soils previously excavated and finished to match the surrounding grade with clean fill from off-site sources.

TABLE 3-1
SUMMARY OF SAMPLING AND ANALYSES
SITE INVESTIGATION
NAVAL AIR STATION – FORMER FIRE TRAINING AREA (SITE 11)
BRUNSWICK, MAINE

SAMPLE EVENT	NUMBER OF SAMPLES		SAMPLE ANALYSES	ANALYTICAL METHOD (2)
	Test Pits (# per test pit) (1)	UST Excavation (1)		
Soil Sampling	2	6	TCL Volatile Organic Compounds	CLP SOW OLMO1.8*
	2	6	TCL Semivolatile Organic Compounds	CLP SOW OLMO1.8*
	2	6	TCL Polychlorinated biphenyls (PCBs)	CLP SOW OLMO1.8*
	2	6	TCL Pesticides	CLP SOW OLMO1.8*
	2	6	TAL Metals	CLP SOW ILMO2.1*
	0	6	Total Petroleum Hydrocarbons (TPH)	Maine 4.1.2**

NOTES:

(1) Number of samples does not include QA/QC samples (see Table 3-3). Number of samples may vary based on field observations.

(2) NEESA QC Level "C" will be used for all samples.

* or most current version of the SOW

** or an alternative approved by the MEDEP

TABLE 3-2
SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS
NAVAL AIR STATION – FORMER FIRE TRAINING AREA (SITE 11)
BRUNSWICK, MAINE

SAMPLE MEDIUM	ANALYSIS	SAMPLE CONTAINER	PRESERVATIVE	LABORATORY HOLDING TIME (1)
Soil	Volatile Organic Compounds	4 oz. wide mouth jar	Cool to 4 deg. C.	7 Days
	Semivolatile Organics	8 oz. wide mouth jar	Cool to 4 deg. C.	7 Days
	Polychlorinated biphenyls	8 oz. wide mouth jar	Cool to 4 deg. C.	7 Days
	Pesticides	8 oz. wide mouth jar	Cool to 4 deg. C.	7 Days
	TAL Metals	8 oz. wide mouth jar	Cool to 4 deg. C.	180 Days*
	Total Petroleum Hydrocarbons	4 oz. wide mouth jar	Cool to 4 deg. C.	14 Days
Aqueous (Rinsate Blank)	Volatile Organic Compounds	40 ml VOA vial	HCl to pH<2/Cool to 4 deg. C.	5 Days
	Semivolatile Organics	80 oz. amber w/ Teflon lined-lid	Cool to 4 deg. C.	5 Days
	Polychlorinated biphenyls	80 oz. amber w/ Teflon lined-lid	Cool to 4 deg. C.	5 Days
	Pesticides	80 oz. amber w/ Teflon lined-lid	Cool to 4 deg. C.	5 Days
	TAL Metals	1 L polypropylene or glass	HNO3 to pH<2/Cool to 4 deg. C.	6 Months
	Total Petroleum Hydrocarbons	1 L glass jar	H2SO4 to pH<2/Cool to 4 deg. C	7 Days

NOTE:

(1) Holding time begins from the date of sample collection in the field.

* Holding time for Mercury is 28 days.

TABLE 3-3
FIELD QUALITY CONTROL SAMPLE SUMMARY
NAVAL AIR STATION - FORMER FIRE TRAINING AREA (SITE 11)
BRUNSWICK, MAINE

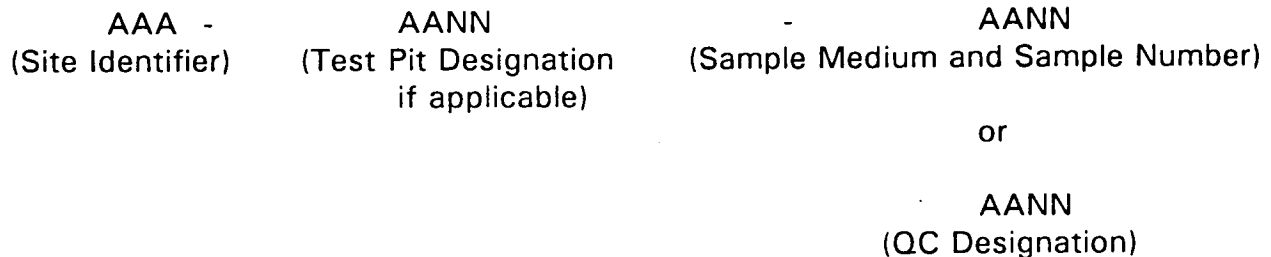
SAMPLE MEDIUM	ANALYSIS	NUMBER OF SAMPLES		FIELD DUPLICATES (1)	TRIP BLANKS (2)	FIELD BLANKS (3)	RINSATE BLANKS (4)	TOTAL QC SAMPLES
		Test Pits	UST Excavation					
Soil	Volatile Organic Compounds	28	6	4	5	2	5	16
	Semivolatile Organics	28	6	4	0	2	5	11
	Polychlorinated biphenyls	28	6	4	0	2	5	11
	Pesticides	28	6	4	0	2	5	11
	TAL Metals	28	6	4	0	2	5	11
	Total Petroleum Hydrocarbons	0	6	1	0	2	1	4

NOTES:

- (1) Field Duplicates are to be collected at 10% frequency.
- (2) Trip Blanks consist of laboratory grade water that accompanies each shipping container.
- (3) Field Blanks consist of source water used for decontamination (1 per water source per sampling event).
- (4) Rinsate Blanks are collected for each sample train used each day (1 per day of sampling).
Initially every other day's rinsate blanks are analyzed.

4.0 SAMPLE DESIGNATION SYSTEM

Each sample collected from the site for laboratory analysis will be assigned a unique sample tracking number. This number will consist of a two- or three-segment, alphanumeric code that identifies the site, the sample medium, and the location-specific sample number. The quality control samples will use the site identifier and the QC designation. Any other pertinent information regarding sample identification will be recorded in the field logbooks or on sample logsheets (included in Attachment B). The alphanumeric coding system to be used is explained in the following diagram and subsequent definitions:



Character type:

A = Alpha
N = Numeric

Site Identifier:

FTA = Fire Training Area

Test Pit Designation:

TP = Test Pit

Sample Medium:

SS = Soil Sample

Location Number:

All soil samples collected from the test pits will use the unique number designated for each test pit as part of the location number. The soil samples collected in each test pit will be sequentially numbered (01 and 02). The soil samples collected from the UST excavation will not use the test pit designation code.

QC Sample Designation:

To be assigned, as applicable, as follows:

DU = Duplicate

TB = Trip Blank

FB = Field Blank

RB = Rinsate Blank

The QC samples will only use the site identifier and a sequential numbering system to ensure submission of a blind QC sample to the laboratory. The actual location the QC sample represents will be recorded in the field logbook and on the HNUS chain-of-custody copy only.

5.0 SAMPLE EQUIPMENT AND PROCEDURES

Field sampling will include the collection of soil samples and IDW samples, as well as QA/QC samples during the tasks described in Section 3.0. General field sampling and sample documentation procedures are described in the Halliburton NUS SOPs appended to this FSP (Attachment B). Pertinent SOPs that may be applicable to this project include, but are not limited to:

- GH-1.3 - Soil Sampling
- SA-6.1 - Sample Identification and Chain of Custody
- SA-6.2 - Sample Packaging and Shipping
- SA-6.3 - Site Logbook
- SF-1.2 - Sample Preservation
- SF-2.3 - Decontamination of Chemical Sampling and Field Analytical Equipment
- Attachment C - Headspace Screening Procedure

All samples will be collected and analyses performed in accordance with EPA CLP Standard Methods and NEESA Level C QA/QC protocols. Approximately fifteen QA/QC samples will be collected. Refer to Tables 3-1, 3-2, and 3-3 for the sample requirements.

6.0 SAMPLE CUSTODY AND SHIPPING PROCEDURES

To ensure the integrity of a sample from collection through analysis, an accurate, written record must be developed that traces the possession and handling of the sample. This documentation is referred to as the sample chain of custody (COC), which must be maintained at all times and documented in accordance with SOP SA-6.1. Chain of custody begins at the time the sample is collected and is maintained by storing the samples (on ice in coolers) in locked field vehicles or within view of Halliburton NUS personnel. Sample documentation must also verify the chain of custody throughout sample packaging, shipping, laboratory receipt, and analyses, as detailed in SOP SA-6.1 (Attachment B).

All samples to be shipped for analysis will be labeled in accordance with the "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program" by the Naval Energy and Environmental Support Activity (NEESA 20.2-047B). Sample labels shall include the following information:

- Site name
- Assigned sample number
- Date and time of sample collection
- Designation of the sample as a grab
- Type of sample (matrix) and a brief description of the sampling location
- Signature of the sampler
- Sample preservation used
- Type of analysis to be conducted

An example of the sample label is included in Attachment B.

The COC record that accompanies the samples through shipment to the laboratory will include the following information, as specified in the NEESA document referenced above:

- Project name
- Signature of samplers
- Assigned sample number
- Date and time of sample collection
- Designation of the sample as a grab
- Sample matrix
- Brief description of the type of sample and sampling location

Signatures of individuals involved in sample transfer (i.e., relinquishing and accepting samples) and date and time samples are relinquished and received

Prior to shipment, the method of shipment, the courier's name, and any other pertinent information shall be entered on the COC record. The original of the record shall be sealed in plastic inside the shipping container to accompany the shipment; a copy of the record shall be retained by field personnel. An example of the Chain-Of-Custody Record is included in Attachment B of this FSP.

Samples shall be shipped in accordance with all applicable state, federal, and Department of Transportation regulations, and as specified by NEESA. Samples that must be cooled to 4 degrees Celsius shall be shipped on ice in insulated containers, which shall be secured with nylon strapping tape and custody seals. Ice will be sealed in separate bags to prevent leakage into the coolers. The custody seals will be signed and dated and will allow the recipient to quickly identify any signs of tampering that may have occurred during transport. Samples shall be shipped by overnight courier within 24 hours of collection to allow the laboratory to meet required holding times.

7.0 QUALITY CONTROL SAMPLE COLLECTION

Quality control samples will be collected to ensure procedures followed are adequate to protect sample integrity. These will include:

- Trip blanks - are used to detect potential contamination by VOCs during sample shipping and handling. Trip blanks are 40-ml volatile organic compound (VOA) vials of American Society for Testing and Materials (ASTM) Type II water that are filled in the laboratory, transported to the sampling site, and returned to the laboratory with the VOC samples. Each trip blank is to be stored at the laboratory with associated samples and analyzed with those samples. Trip blanks are only analyzed for VOCs.
- Rinsate blanks - are samples of ASTM Type II water passed through decontaminated sampling equipment. They are used as a measure of decontamination process effectiveness. Equipment rinsates are collected at the rate of one per day per sampling train. Equipment rinsates are analyzed for the same analytes as samples collected that day. Sample preservatives must be added to the rinsate blanks. Initially, samples from every other day should be analyzed. All other rinsate blanks will be marked "HOLD". If analytes pertinent to the project are found in the rinsate blanks, the remaining samples should be analyzed.
- Duplicates/Splits - are used to assess the variability of sampling, preservation, storage, and the analysis process. Soil sample duplicates/splits are collected and homogenized before being split. Samples submitted for VOC analyses are not to be homogenized or split. Field duplicates for water will be collected simultaneously.
- Field blanks - are samples of source water used for decontamination and steam cleaning. At a minimum, one sample for each source of water for a given event will be collected for analyses.

A summary of quality control samples to be collected during this project are presented in Table 3-3.

8.0 DECONTAMINATION PROCEDURES

Sampling Equipment

All non-disposable sampling equipment, such as stainless steel trowels and bowls, that comes in contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. The following decontamination sequence will be employed:

- remove gross contamination with potable water
- scrub with potable water/liquinox
- rinse with potable water
- rinse with methanol, air dry
- rinse with laboratory grade hexane, air dry
- rinse with deionized water, air dry

9.0 HANDLING OF INVESTIGATION-DERIVED WASTE (IDW)

Waste materials that will be generated during the field investigation may include decontamination fluids and used personal protective equipment (PPE). These wastes will be handled as follows:

- Decontamination fluids, which may contain small amounts of detergent (alconox/liquinox), methanol, hexane, and rinse water, will be drummed.
- Disposable sampling equipment and used PPE will be decontaminated (rinsed and, if necessary, scrubbed), double-bagged, and disposed of in the Halliburton NUS on-site industrial dumpster.

ATTACHMENT A
SITE-SPECIFIC HEALTH AND SAFETY PLAN

Health and Safety Plan for the

**Site 11 - Fire Training Area (FTA)
Naval Air Station
Brunswick, Maine**



**Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 121**

October 1994

HEALTH AND SAFETY PLAN
FOR THE

SITE 11 - FIRE TRAINING AREA (FTA)
NAVAL AIR STATION
BRUNSWICK, MAINE

Submitted to:
Northern Division
Environmental Branch, Code 18
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

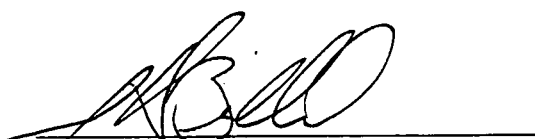
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993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087

CONTRACT NUMBER N62472-90-D-1298
"CLEAN" Contract Task Order No. 121

October 1994

SUBMITTED FOR HALLIBURTON NUS BY:


JANET A. PILLION
HEALTH AND SAFETY OFFICER


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PROJECT MANAGER
HALLIBURTON NUS CORPORATION
WILMINGTON, MASSACHUSETTS

APPROVED BY:



MATTHEW M. SOLTIS, CSP
CLEAN HEALTH AND SAFETY MANAGER

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) was prepared to provide safe procedures and practices for HALLIBURTON NUS Corporation and subcontractor personnel engaged in Removal Action/Disposal activities at the Naval Air Station's former Fire Training Area (FTA) - Site 11, located in Brunswick, Maine.

This plan has been developed to conform to the requirements of 29 CFR OSHA Standard 1910.120 (Hazardous Waste Operations and Emergency Response) as well as guidance set forth in the CLEAN Health and Safety Management Plan (HSMP) developed by HALLIBURTON NUS (dated August 1991), and is based on the available information concerning possible contaminants and physical hazards that exist, or may exist, on the site.

As more data concerning the nature and/or concentrations of contaminants becomes available, the Health and Safety Plan will be modified accordingly. Modifications will be determined by the Health and Safety Officer (HSO). They will be communicated via task specific health and safety plans obtained by field personnel prior to each new site visit.

All activities covered by this HASP must be conducted in complete compliance with this HASP and with all applicable federal, state, and local health and safety regulations.

Subcontractors performing work onsite will be required to comply with the minimum requirements of this plan. Each subcontractor employee performing work at the site must complete a copy of the HASP review form (Attachment A) indicating that the individual has read, understands, and will comply with the HASP.

1.1 KEY PERSONNEL/RESPONSIBILITIES

The HALLIBURTON NUS Project Manager (PM) is responsible for the overall direction and implementation of the project tasks and is, therefore, ultimately responsible for the implementation of this HASP. Specifically, the PM is responsible for collecting the training and medical documentation and HASP review form(s) from the HALLIBURTON NUS field team and subcontractors and forwarding these documents to the HSO and CHSM.

The CLEAN Health and Safety Manager (CHSM) is responsible for oversight of health and safety issues in conjunction with this project. The CHSM must approve any modifications to this HASP after finalization.

On-site health and safety issues will be delegated to the Site Safety Officer (SSO). This individual will be responsible for day to day implementation of the HASP and its requirements. As a part of this role, the SSO is responsible for assisting the CSHM in ensuring compliance with the CLEAN Health and Safety guidelines and to provide technical expertise for this project. The SSO has the authority to stop all work where imminent danger is perceived and is responsible for initiating emergency response and coordinating site evacuation when necessary.

The HALLIBURTON NUS Site Supervisor is responsible for the day to day operations at the site, and shall support the SSO in implementation of this Health and Safety Plan.

Any personnel performing work at the Site must be approved by the HALLIBURTON NUS Project Manager and the CLEAN Health and Safety Manager (CHSM) prior to the commencement of field activities.

Site Name: Former Fire Training Area - Site 11

Address: Intersection of Old Gurnet and Sandy Roads in the central portion of NAS
Brunswick
Brunswick, Maine

Site Contact: Jim Caruthers
Phone No.: (207) 921-2445

Client Contact: Fred Evans (Navy Remedial Project Manager)
Phone No.: (215) 595-0567 x 159

Purpose of Site Visit: Removal Action/Disposal

Proposed Date of Work: October 1994

PERSONNEL ASSIGNMENTS

HALLIBURTON NUS Personnel

Assignment

John Trepanowski
Gordon Bullard
TBA
Matthew Soltis
Janet Pillion

TBA

CLEAN Program Manager
Project Manager
Site Supervisor
CLEAN HSM
Health & Safety Officer (HSO)/Site
Safety Officer (SSO)
Tech. Staff

Non-HALLIBURTON NUS Personnel

Purpose

TBA	Excavation/Recontainerization Subcontractor
TBA	Geophysics Subcontractor
TBA	Waste Disposal Subcontractor

Plan Reviewed and Approved by: _____ (___/___/___)

HALLIBURTON NUS Project Manager: _____ (___/___/___)

MODIFICATION OF THIS HASP IN THE FIELD MUST BE APPROVED BY THE HEALTH AND SAFETY OFFICER (HSO)

2.0 SITE BACKGROUND

NAS Brunswick, located south of the Androscoggin River between Brunswick and Bath, Maine, is an active base supporting the U.S. Department of the Navy's antisubmarine warfare operations in the Atlantic Ocean and Mediterranean Sea. Its primary mission is to operate and maintain P-3 Orion aircraft. NAS Brunswick first became active in the 1940s during World War II, and underwent major expansion in the 1950s.

The former FTA - Site 11 is located near the intersection of Old Gurnet and Sandy Roads in the central portion of NAS Brunswick. The FTA reportedly had been used for training purposes since the 1950s, and probably since World War II. A 1959 aerial photograph shows a large blackened area at the current location of the FTA. Fire-fighting exercises at the FTA introduced various liquids into soils at the site, including waste oils, fuels, solvents, and other miscellaneous liquids. There were multiple annual "burns" during the 40-to-50-year time of use. Reportedly, the only measure taken before 1987 to control infiltration of the liquids into the soils was to saturate the ground surface with water to float the product prior to a burn. In 1987, the FTA was upgraded with the installation of a concrete liner and berms. Additionally, a collection system, including piping and a 6,000-gallon fiberglass underground storage tank (UST), was installed north of the pit to contain unburned liquids.

Reportedly, most of the fuel used for fire-fighting exercises was JP-5 jet fuel or aviation gasoline (AVGAS), but there was no quality control for what would eventually be used at the fire pit. Anything may have been brought to the site from any source on base if it was thought that the material might be flammable. Typically, barrels containing JP-5 obtained from the different squadrons on base would be brought to the site, temporarily stored, then rolled to the fire pit and emptied of their contents for the fire fighting exercises. There was always just one fire pit at the site and that the storage area for these drums was located west of the fire pit. Once emptied, the drums were typically brought to the Defense Reutilization and Marketing Office for disposal.

Sometime between 1970 to 1980, there reportedly was a one-time event of drums being buried in a trench of unknown dimensions. The exact location of the trench or the number or contents of the drums is unknown but estimates indicate that there were between 10 and 20 drums, and the general location was north of the pit and possibly into the woods west of the present location of the UST. It is unknown why the drums were buried, since any flammable liquids would presumably have been burned. The fact that some drums were buried may indicate that the contents were not flammable.

The 1993 magnetometer and GPR surveys of Site 11 identified a number of locations with anomalous geophysical signatures. Subsequent test-pitting activities uncovered drums in five separate locations. The condition of the drums was consistent with a reported disposal date of 10 to 20 years ago. The amount of liquids or sludges remaining in these drums is unknown. Due to the deteriorated condition of the drums and the need to minimize the possibility of rupturing them, most of them were left in the ground, although several were removed and temporarily stored above-ground at the site. It is not known how many additional drums may be present in these locations. TCLP analyses of samples from two drums indicated that one of the drums was nearly pure methyl ethyl ketone (MEK), an industrial solvent, and one was water contaminated with approximately 0.15% MEK. A third drum sample contained low levels of fuel-related compounds.

For more detail regarding site background information, refer to the Action Memorandum/Work Plan document.

3.0 SCOPE OF WORK

The sections presented below are abbreviated descriptions of work to be performed as a part of the Removal Action and Disposal activities at the FTA - Site 11 property in Brunswick, Maine. For more detail of the work to be performed, refer to the Action Memorandum and the Field Sampling Plan.

In general, the following tasks will be performed:

- UST Sampling
- Test Pit Excavations
- Removal and Recontainerization of Buried Drums & Containers
- Soil Sampling
- Magnetometer Survey
- Excavate, Clean, and Removal of UST

4.0 HAZARD ASSESSMENT

This section presents information regarding known and suspected chemical and physical hazards associated with the investigatory activities at the Site. Only those activities anticipated in this HASP are considered in this evaluation. Any additional activities must be communicated to the CHSM for inclusion into this plan. This evaluation is based solely on the currently available information. As new data comes available, this HASP may need to be modified accordingly.

The types and degree of potential hazards that may be presented to site personnel vary depending on factors such as the task to be performed, the location involved, climatic conditions, etc. The site tasks scheduled to take place in this project can generally be segregated into two categories: intrusive and nonintrusive. The types and degrees of risks recognized in this project are more significant in regard to the intrusive activities (i.e. excavating, soil sampling, etc.) rather than the nonintrusive operations (i.e. site walkovers, geophysics, etc.).

4.1 CHEMICAL HAZARDS

Hazards associated with this investigation include the potential for exposure to site contaminants via inhalation of toxic vapors and/or airborne particulates, dermal contact, and (to a much lesser extent) ingestion.

4.1.1 Methyl Ethyl Ketone

OSHA PEL: 200 ppm	Maximum concentrations detected onsite:
Short Term Exposure Limit: 300 ppm	Buried drums containing pure product
IDLH: 3,000 ppm	(110 %)
Odor Threshold: 10 ppm	

Methyl ethyl ketone (or 2-butanone) is a colorless flammable liquid with a moderately sharp, fragrant, mint- or acetone-like odor. If high concentrations of vapors are inhaled they are irritating to the eye, nose and throat and will cause vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Target organs in the event of an exposure is the central nervous system (CNS) and the lungs. Use of organic cartridge or air supplied respirators provide personal respiratory protection.

4.1.2 Fuel-related Compounds

No exposure limits established.
Odor Threshold: 1 ppm

Previous site activities and observations indicate the potential for fuel oil or gasoline contamination, specifically JP-5 jet fuel to be present on-site. Fuel oils are considered to be of moderate to low toxicity and are not considered to be carcinogenic by NTP, OSHA, or IARC. Potential route(s) of entry are inhalation and skin/dermal contact. Fuel oil health hazard data sheets present dermal exposure as the primary route of concern. Federal or recommended airborne exposure limits have not been established for fuel oil vapors; however, the following toxic and hazardous ingredients of petroleum hydrocarbons potentially include: benzene, cyclohexane, heptane, methyl cyclohexane, toluene, octane, xylenes, nonane, and hexane. Effects of short-term (acute) overexposure may be indicated by symptoms such as headache, dizziness, blurred vision, drowsiness, dermatitis, difficulty in breathing, irritations of the eyes, nose and throat, and at extremely high concentrations death may occur. Chronic effects of overexposure include: hydrocarbons - nausea, headache, dry, cracked skin; benzene - irritation of nose, eye, respiratory system, nausea, lassitude. Effects of long-term (chronic) overexposure typically result in the development of chronic dermatitis.

Because of the work being conducted in an outdoor environment, overexposure to fuel related vapors is not expected to occur. Dermal contact is the most likely route of exposure.

Material Safety Data Sheets (MSDS') state that no special respiratory protection is required when working with fuel oil under normal conditions of use and with adequate ventilation. For skin protection, impervious gloves (i.e. viton, nitrile) or clothing is recommended when continuous exposure is expected to prevent repeated or prolonged skin contact.

4.1.3 Aviation Gasoline (AVGAS)

OSHA PEL: Not Established

ACGIH TLV: 300 ppm

STEL: 500 ppm

Odor Threshold: 0.25 ppm

AVGAS is a watery red, blue, green, brown, or purple, aromatic volatile liquid. Inhalation of AVGAS vapors is mildly toxic and causes irritation of upper respiratory tract and causes: cough, conjunctiva irritation, hallucinations or distorted perceptions, and central nervous system depression. Even brief inhalations of high concentrations can cause a fatal pulmonary edema. Repeated or prolonged dermal exposure causes dermatitis and can cause blistering of skin. AVGAS is a Class 3 flammable liquid and presents a very dangerous fire hazard; AVGAS vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.

4.1.4 Other Chemicals

Material Safety Data Sheets (MSDS) for decontamination solutions that field crews will use during the investigation are presented as Attachment B. All containers of decon solutions will be properly labeled in accordance with OSHA's Hazard Communication Standard, 29 CFR 1910.1200 and 1926.59.

The most likely route of exposure for these chemicals is through dermal exposure, although ingestion and eye contact via a potential splash hazard exists.

4.1.5 Chemical Hazard Evaluation of Each Site Task

Although there are numerous tasks outlined in the Scope of Work, many utilize the same type of activities to complete them. Due to this fact, work activities will be grouped as appropriate and addressed in this section instead of each individual site task. A hazard evaluation for these work activities is as follows:

Excavations/Soil Sampling (in excavation)/Drum & Debris Removal/UST Removal

Excavation (test pitting) activities, buried drums and UST removal and other soil and waste disturbing activities present the highest exposure potentials of this investigation. Exposure concerns include inhalation of toxic vapors or contaminant-laden dust caused by soil or waste disturbance, and direct skin contact with contaminants. The physical hazards associated with these tasks are addressed in Section 4.2 of this HASP. Specific drum handling protocols are addressed in Section 11.0 of this HASP.

Exposure potentials could vary significantly depending on the potential contents of the buried drums and concentration levels of potentially contaminated soils encountered during excavation activities; activities or disturbances in known or potential waste sources or debris poses the greatest risk of worker exposure. Heavy equipment operators and other workers are especially at risk to exposure due to their work position proximity to the test pits, waste containers, and contaminated soils or other potentially contaminated material or media (inhalation), or during handling of potentially contaminated soil and containers (dermal contact).

UST Sampling/Soil Sampling

This task presents a moderate exposure potential. The primary concern for these tasks is inhalation of volatile organic compounds and contaminated particulates while sampling potentially contaminated soil and dermal contact with fuel-related products or contaminated soil. The hazards presented during soil sampling may vary depending on the test pit locations; organic vapors at potentially toxic concentrations may be generated at some locations.

Site Walkovers/Magnetometer Survey

These tasks present a low exposure potential due to the non-intrusive nature of the activity. It is not anticipated that an exposure to contaminant-laden particulates or volatile organic compounds would occur during these tasks. If information collected during site activities indicates the potential for exposure then these tasks will be reevaluated.

4.1.6 Control of Chemical Hazards

Exposure to site contaminants will be controlled through the use of the following elements:

- Personal Protective Equipment (PPE) - PPE consisting of protective clothing, and respiratory protection, as necessary, to reduce/eliminate exposure to contaminants. For specific PPE requirements, refer Section 6.0.
- Air Monitoring - Work area monitoring will be performed with a flame ionization detector (FID) or a photoionization detector (PID) calibrated to respond to the compounds identified previously in this section. Additionally, an LEL/O₂ meter and a radiation meter will also be used during on-site activities. The readings detected on the air monitoring instruments will be used to determine the need for respiratory protection during work at the site (refer to Sections 5.0 and 6.0 of this HASP).
- Decontamination Procedures - Personal and equipment decontamination procedures were established to reduce/eliminate personnel exposure to site contaminants and to control the migration of contamination from dirty to clean areas. Specific decontamination requirements are outlined in Section 8.0.
- Safe Work Practices - Safe work practices, such as those found in Section 4.2.1 and 7.2, will be followed to aid in the efforts to reduce exposure.

4.2 PHYSICAL HAZARDS

Physical hazards are also a serious concern to site personnel involved with field activities. These may be intrinsic to the nature of the operation being performed, or the result of factors such as the work location or schedule. These potential risks include the following:

- Excavations/Test Pitting

Contact with subsurface/energized utilities during subsurface operations.

- Exposure to moving machinery - struck by/caught between hazards (e.g. point of operation areas, nip points, etc.).
- Noise in excess of 85 dBA.
- Uneven or unstable terrain - could cause slip/trip/fall type hazards.
- Strain or muscle pulls from manual lifting.
- Heat/Cold stress.
- Accidents associated with working in areas of vehicle traffic.
- Inclement weather
- Natural hazards (e.g. snakes, ticks, mosquitos, poisonous plants, etc.).

4.2.1 Control of Physical Hazards

Control efforts for these physical hazards include the following:

Excavations/Test Pitting - Excavations pose a physical hazard to workers. Fatalities resulting from poor trenching/excavating practices occur regularly in the work place. All excavation work will comply with the requirements given in 29 CFR 1926 Subpart P.

- No entry into excavations will be permitted unless adequately protected as specified in 29 CFR 1926 Subpart P.
- No entry into excavations that are a permit-required confined space without satisfy all of the applicable requirements as presented in 29 CFR 1910.146.
- Excavations of 5 feet or greater will be securely shored or the walls will be bench-cut or sloped at an angle well below the angle of repose of the surrounding soils but not less than one and one-half horizontal to one vertical (34° measured from the horizontal).
- Personnel may not approach a test pit closer than 2 feet from the edge and spoils will be stored at least 2 feet from the edge of an excavation. Unstable pits must be sloped at the side to prevent cave-in.

The SSO shall frequently inspect test pits for slide or cave-in potential.

- Personnel must not lean over excavations.
- Open pits must be staffed by site personnel at all times. No open excavation will be left unattended unless properly barricaded.
- Restrict the excavation work area to authorized personnel only.
- Water will not be allowed to accumulate in an excavation.
- Vibration sources or heavy objects will not be situated on the edge of an excavation unless measures are taken to ensure the stability of the wall.
- All personnel must stand upwind of the test pits and away from the reach of the backhoe, tires, and outriggers.
- The backhoe operator must be instructed not to undermine the excavation.
- All work areas must be kept free of ground clutter.

Contact with Subsurface Utilities/Energized Sources

One of the hazards associated with the execution of this scope of work is the potential for encountering energized sources (i.e. pressurized lines, water lines, telephone lines, and buried utilities such as gas or electric lines), primarily while engaged in subsurface activities. Due to the obvious ramifications associated with this hazard, extreme caution and strict adherence to procedures to detect, identify, and take evasive action shall be followed during the completion of the scope of work. A DIGSAFE permit number shall be obtained prior to any subsurface work. Any areas targeted for subsurface activities shall first be investigated to determine the presence of underground utilities and such utilities identified shall be physically marked and avoided. Efforts will be made through local contacts, as-built drawings (where available) along with geophysical surveys to identify potential locations. Positive readings will require the relocation of an excavation. To further avoid hazards of this type, no heavy equipment shall be permitted within a 20-foot radius of any energized source.

Exposure to Pinch/Compression Points

Personnel are to be advised of struck by/caught between type hazards related to hand/clothing contact with moving machinery. Protective gear must fit properly and be taped, when applicable, not only to control chemical exposure, but also to avoid

contact with moving machinery. Additionally, equipment shall be shut down and locked out before maintenance functions are performed. All mechanized equipment brought on-site (e.g. excavation equipment) to complete this scope of work will be inspected initially prior to the commencement of on-site activities and then periodically thereafter. These inspections will be performed by the SSO and include the following:

- All safety guards are in place
- All safety-restraints (i.e., seatbelts) are in place and functioning properly as required by Federal regulations
- All mobile equipment is equipped with a backup alarm and emergency stop device
- All operators are qualified to do so. All drivers will be required to have their Commercial Drivers License
- All maintenance performed on the equipment will employ manufacturers recommended parts and be inspected prior to returning to services by the SSO

Strain/Muscle Pulls

During any manual handling tasks, personnel are to lift with the force of the load supported by their legs and not by their backs. The correct number of personnel must be used to lift or handle heavy equipment. These procedures are to be employed to attempt to avoid back strain and/or other injuries.

Heat/Cold Stress

Worker overexposure to heat is a recognized potential hazard due to possible ambient temperatures combined with the use of personnel protective equipment which can contribute to this threat. It will be the responsibility of the Site Supervisor, with assistance from the SSO, to determine the need to employ heat stress monitoring techniques and control measures based on observations of site conditions and personnel. Generally, consideration for these efforts are to commence if/when ambient weather conditions involve temperatures in excess of 70 degrees Fahrenheit. Additionally, cold stress is also a recognized potential hazard posed to workers. Refer to Attachment D for recognition, evaluation, and control of these potential hazards.

Buddy System

The activities conducted and equipment utilized during the site work demand competency, coordination, and concentration. To prevent accidents and injuries occurring on-site, and in order to provide rapid assistance to employees in the event of an emergency, implementing the "buddy system" or organizing employees to support "line-of-sight" is required.

The buddy system will be implemented in all work areas where there exists the potential for a significant chemical exposure and work areas proximal to vehicle traffic, heavy equipment and other machinery or equipment that poses a threat of serious injury to on-site workers. Line-of-site or a communication system can be via visual, voice, or regular radio contact and must be maintained at all times.

Natural Hazards

Natural hazards such as poisonous plant, bites from poisonous or disease carrying animals or insects (e.g., snakes, ticks, mosquitos) cannot be avoided in this type of environment. However, in an effort to offset the impact of this hazard, field personnel will have access to commercially available snake bite kits and insect repellents. Potential nesting areas in and about work areas shall be avoided to the greatest extent possible. Lastly, within recent years a marked increase in Lyme's Disease has been reported. Ticks have been shown to be the primary vector in the transmission of this disease. In an effort to control this hazard, close attention will be given during operations and decontamination with regard to personal hygiene to detect and remove any ticks from personnel.

Overhead/Eye Hazards

Head protection (hard hats) will be required whenever and wherever potential overhead hazards are recognized, including when in the vicinity of any operating heavy machinery. Eye protection will be required wherever potential eye hazards are recognized.

Inclement Weather

Incidents of inclement weather will be evaluated by the Site Supervisor, with input from the SSO, in regard to limiting or interrupting site operations. At a minimum, however, site operations will be interrupted in the event of electrical storms and other severe conditions (e.g., torrential rain, high wind, etc.).

Noise Exposure

Elevated sound levels may be generated as a result of activities onsite which may cause hearing damage and/or be a hinderance to communication.

- - Noise levels are not to exceed the 8-hour time-weighted average OSHA action level of 85 dBA without the use of hearing protection. As a general rule-of-thumb, hearing protection will be required if personnel standing approximately 2 feet apart cannot converse without raising their voices to be heard.

The use of hearing protection, either ear muffs or ear plugs, will be used during all noisy field activities (i.e. excavating) to effectively reduce noise levels.

4.2.2 Confined Space Entry Operations

Site activities that may require personnel entry into structures, containers or excavations that could be considered to be permit-required confined spaces, as defined by OSHA Standard 1910.146, are not authorized under this HASP. An addendum to this HASP will need to be prepared prior to any entry into a permit-required confined space.

Any efforts that require the entry of personnel into an excavation will be limited to excavations that are significantly sloped to allow for ready personnel access and egress, and all applicable requirements of OSHA Construction Industry standards for excavation (29 CFR 1926, Subpart P: Excavations) will be observed as minimum requirements. Also, any such excavations will be thoroughly evaluated in accordance with the requirements of OSHA Standard 1910.146 to ensure that the space is not a permit-required confined space. To satisfy this requirement, and to allow personnel entry, all of the following conditions must be satisfied:

- The space may not contain (or have the potential to contain) a hazardous atmosphere (as defined in 29 CFR 1910.146)
- The space must not contain a material that has the potential to engulf or entrap an entrant
- Must be excavated so that the configuration is not such that an entrant could be trapped or asphyxiated by inward converging sides or by a floor which slopes downward in the work area and tapers to a smaller cross-section
- Space does not contain any other recognized serious safety or health threat

If any one of these conditions is suspected to exist absolutely no entry will be permitted. In such an instance, the CHSM must be contacted for guidance.

5.0 AIR MONITORING

This section presents requirements for the use of real-time air monitoring instruments during site activities involving potential for exposure to site contaminants. It establishes the types of instruments to be used, the frequency of which they are to be used, techniques for their use, action levels for upgrading/downgrading levels of protection, and methods for instrument maintenance and calibration.

5.1 INSTRUMENTS AND USE

Air monitoring using a photoionization detector (PID) or a flame ionization detector (FID) will be conducted onsite in the breathing zone of high risk workers during subsurface explorations and during any other activity deemed necessary to determine the presence or absence of ionizable volatile organic compounds. Additionally, an LEL/O₂ meter and a Radiation Survey meter will also be used onsite.

The HNu-PI101, a PID, equipped with a 10.2 eV lamp, or the OVA Model 128 FID, will be used to detect the presence or absence of airborne ionizable chemical gases and vapors. The PID/FID will be calibrated and operated as outlined in the HNUS Standard Operating Procedures (SOPs). The HNu does not detect methane. The OVA 128 does detect methane; if there are any sustained readings in the breathing zone using the OVA 128, the methane screening technique will be used to determine if there are other VOCs present. Respiratory protection upgrade need not occur if the readings are determined to be from methane and are less than 10% of the Lower Explosive Limit (LEL) reading.

A combustible gas (lower explosive limit (LEL) and oxygen (O₂) alarm meter will be used to monitor levels of combustible gas and oxygen deficient atmospheres during subsurface, handling of buried wastes and sampling activities. The LEL/O₂ meter will be calibrated using pentane (0.75 percent by volume in air) and operated as outlined in the HNUS SOPs. If airborne concentrations of flammable vapors exceed 10 percent or greater of the LEL, no work will take place until the source of the emission has been identified and control measures instituted or until vapor concentrations subside.

A radiation survey meter will be used to monitor for potential sources of ionizing radiation. The survey meter will be calibrated as recommended by the manufacturer and in accordance with the HNUS SOPs. If there are readings detected above an established background level for the area, then work will be terminated and the area evacuated until the type and amount of radioactivity is established.

In summary, the following air monitoring instruments will be utilized during the following tasks as specified above and in accordance with the action levels specified in Section 3.3:

Site Walkovers/Magnetometer Survey - PID/FID & Radiation meter for initial site entry

- Excavations/Removal & Recontainerization of Buried Drums & Debris/UST & Soil Sampling/UST Removal - PID/FID monitor; LEL/O₂ monitor; Radiation meter

NOTE: It should be realized that contaminated particulates and possibly other contaminants of concern are nondetectable using these types of screening instruments. Therefore, in addition to the use of these screening instruments, emphasis will also be given to visual observations, as these contaminants may present themselves as particulates (or may be bound to particulates). It is also the logic used in selecting respiratory protection as presented in Section 6.0.

5.2 MODIFICATION OF AIR MONITORING REQUIREMENTS

The air monitoring requirements presented in Section 5.1 are based upon the tasks presented in Section 4.1.5 and the assumption that the contaminants presented in Section 4.1 are the only contaminants which pose a reasonable health risk to site workers covered by this HASP. In the event that this assumption is found to be invalid, the requirements will be subject to change.

5.3 ACTION LEVELS

The following action levels will apply to this project:

PID/FID Monitor

0.0 ppm to 5 ppm	Level D [*]
5 ppm to 25 ppm	Level C [*]
Greater than 25 ppm	Level B
Greater than 50 ppm	Stop work and contact HSO or CHSM

LEL/O₂ Meter

< 19.5%	Level B
> 23.5% oxygen content in air	Retreat immediately ^{**}
> 10% LEL readings	Retreat immediately ^{***}

Radiation Meter

> Established Background Levels	Retreat immediately and contact HSO or CHSM
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These action levels are based upon the assumption that volatile organic compounds typical of petroleum products will be the only air contaminants which pose a reasonable health risk to site workers. In the event that this assumption is suspected to be invalid, the action levels will be modified as appropriate.

- These respiratory protection levels do not downgrade the respiratory protection requirements as presented in Section 6.0.
- If oxygen enriched atmosphere is the concern, contact the HSO or CHSM for guidance and do not resume until O₂ levels decrease to less than this action level.
- If potentially-explosive action levels are indicated by the exceedence of this action level, retreat immediately to an unaffected area and contact the HSO or the CHSM for guidance.

5.4 INSTRUMENT MAINTENANCE AND CALIBRATION

Air monitoring instruments will be maintained and pre-field calibrated. Field calibration and operational checks will be conducted in accordance with the HNUS SOPs. Field maintenance will consist of daily cleaning of the instruments using a damp towel or rag to wipe off the instrument's outer casing and overnight battery recharging.

5.5 RECORDKEEPING

Instrument calibration notes and readings will be recorded in the respective instrument log. Instrument readings observed during site monitoring activities will be recorded in the field logbook. PID/FID readings above background in the breathing zone must be recorded in the field logbook. This should indicate the date, reading(s) observed, duration of readings, workers potentially affected, and actions taken to reduce exposures.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section presents requirements for the use of personal protective equipment for each of the activities being conducted as defined in Section 3.0 and 4.1.5 of this HASP. This section includes anticipated levels of protection for each of the activities, the criteria used for selecting various levels of protection, and criteria for modifying levels of protection based on personal observations.

6.1 ANTICIPATED LEVELS OF PROTECTION

All work is anticipated to be performed in Levels B, C or D Protection, as defined in Appendix B of OSHA Standard 29 CFR 1910.120 - "Hazardous Waste Operations and Emergency Response." Where activities overlap, the more protective requirements will be applied.

6.1.1 Mobilization/Demobilization/Site Walkover/Magnetometer Survey

Level D Respiratory Protection - (No respiratory protection).

Minimum requirements during these activities include steel-toe/shank work boots. Hardhat will be worn where the potential for overhead hazards may exist. Leather or cotton work gloves will be worn, as needed, to prevent cuts and abrasions when handling equipment.

6.1.2 Excavations/Soil Sampling/Debris Removal/UST Cleaning/Removal & Recontainerization of Buried Drums and Containers

Level B Respiratory Protection - full-face, air-supplying respirators or self-contained breathing apparatus (SCBA). Respiratory equipment must be NIOSH-approved.

Minimum requirements during these activities include hard hat, steel-toe/shank work boots, Tyvek coveralls, disposable boot covers, nitrile, viton, or silvershield gloves over latex/nitrile inner gloves, and hearing protection (to be worn when the potential for noise exposure exists). All ankle and wrist seams will be taped and all loose clothing will be secured. If activities present the potential for Tyvek to become saturated, PVC coveralls will be substituted.

NOTE: Due to the potential for drums to rupture, leak, or spill during removal, workers in the excavation, as well as the HNUS sampler (in the excavation), will always be in Level B - airline supplied respirators (cannot be downgraded). The excavator/backhoe operator must have Level B immediately available at all times. Whenever possible, the excavation equipment will be positioned upwind of the test pit.

6.1.3 UST Sampling

Level C Respiratory Protection - full-face, air-purifying respirators equipped with GMC-H filters. Respirators must be NIOSH-approved.

Minimum requirements during these activities include steel-toe/shank work boots, Tyvek coveralls, disposable boot covers, and nitrile, Viton, or Silvershield gloves over latex or nitrile inner gloves. All ankle and wrist seams will be taped. If activities present the potential for Tyvek to become saturated, PVC coveralls will be substituted.

6.2 PPE SELECTION CRITERIA

Respiratory protection (Level B and C) were selected for use during intrusive activities due to the potential for exposure to potential volatile organic compounds and contaminant-laden particulates that may cause adverse health effects. There are buried drums of pure MEK product and other drums with unidentified contents that will be excavated and recontainerized. Therefore, a more conservative approach is necessary until the site is more completely characterized. Nitrile/Viton/Silvershield gloves were selected to provide protection against potential contamination that could be encountered and to help reduce dermal absorption and ingestion as a result of incidental hand to mouth contact. Hard hats and work boots were selected to provide protection against some of the physical hazards associated with heavy equipment and disposable boot covers were selected to help minimize the spread of contamination. Tyvek coveralls were selected to minimize the potential for contamination of street clothes and PVC coveralls were selected for use in the event that site activities have the potential to result in the saturation of work clothes and dermal contact. Hearing protection was selected to protect against hearing loss due to working with heavy equipment.

6.3 PPE MODIFICATION CRITERIA

This section presents criteria for upgrading and downgrading chemical protective clothing (CPC) and/or respiratory protection. Where uncertainties arise, the more protective requirement will apply.

6.3.1 CPC Modification Criteria

Tyvek coveralls and boot covers must be worn anytime there is a reasonable potential for contamination of street clothes. Polyvinyl chloride (PVC) coveralls must be worn if there is a reasonable potential for saturation of work clothes.

Nitrile, viton, or silvershield gloves must be worn anytime there is a reasonable potential for contact with site contamination.

6.3.2 Respiratory Protection Modification Criteria

Due to the potential for exposure to possible toxic concentrations, respiratory protection is required for work at the site if monitoring instrument readings indicate the presence of volatile organic compounds in the breathing zones of the workers.

Respiratory protection will be modified, based on the following guidelines utilizing the most stringent guideline applicable. Monitoring instrument readings will be initiated at the source of potential emissions (e.g. excavations/test pits, drums, containers, etc.) and then to the workers breathing zone if readings are detected at the source.

Level D protection (no respiratory protection) with appropriate dermal protection will be adequate under the following conditions:

- No odors present, no source PID/FID readings above 5 ppm in the breathing zone, and no signs/symptoms of overexposure.
- Odors detected, but no source PID/FID readings detected above 5 ppm in the breathing zone and no signs/symptoms of overexposure.
- Source PID/FID readings above background but no breathing zone FID readings above 5 ppm.

Level C protection consisting of full face, air-purifying respirators (APR) equipped with GMC-H cartridges (or equivalent) along with appropriate dermal protection will be acceptable under the following conditions:

- Sustained readings above 5 ppm but less than 25 ppm at the source and in the breathing zone.
- Greater than 19.5% O₂ content in air but less than 23.5% O₂.

Level B protection consisting of positive pressure, pressure demand supplied air respiratory equipment or SCBA and appropriate dermal protection will be required under the following conditions:

- Sustained PID/FID readings in the breathing zone above 25 ppm but less than 50 ppm.
- Anytime any odor, irritation, or other discomfort is perceived while wearing an APR which would indicate cartridge failure or breakthrough.
- Not greater than 23.5% O₂ content in air.

Due to the potential for drums to rupture, leak, or spill during removal, workers in the excavation, as well as the HNUS sampler (in the excavation), will always be in Level B (cannot be downgraded). The excavator/backhoe operator must have Level B immediately available at all times.

The respiratory protection action levels presented above are based on monitoring instrument sensitivities and warning properties of the anticipated site contaminants.

7.0 SITE CONTROL MEASURES

Various site control measures are required to prevent accidental injury due to physical and chemical hazards presented by the work performed. These control measures are described in the following subsections.

7.1 WORK ZONES

Various activities will be undertaken in each of the separate work areas. Each location will involve a separate site set-up. The exclusion zone will be designated as the specific excavation, staged waste or other such work location. During work activities, areas will be designated by the use of ropes, flagging, or cones to control pedestrian traffic and the entrance of unauthorized personnel. Each work location will also contain a personnel decontamination station, as part of the Contamination Reduction Corridor (CRC)

The Support Zone, where the administrative, communications, and other support services are based, will be in a controlled area spatially removed from site contamination.

7.2 SAFE WORKING PROCEDURES

The following minimum safe working procedure must be complied with during the performance of work at the Site:

Eating, drinking, chewing gum or tobacco, taking medication, and smoking are prohibited where the possibility for the transfer of contamination exists.

Upon leaving the exclusion zone, hands and face must be thoroughly washed. Any protective outer clothing is to be removed and left at a designated area prior to entering the clean area.

Contact with potentially contaminated substances must be avoided. Equipment must not be placed on potentially contaminated surfaces.

All personnel and equipment must be thoroughly decontaminated prior to leaving the site.

All personnel must review and understand the site-specific Health and Safety Plan prior to commencing work on site.

All personnel must satisfy training requirements and medical monitoring procedures as specified by OSHA regulations referenced in 29 CFR 1910.120.

No flames or open fires will be permitted on site.

All underground utilities must be positively identified and marked prior to subsurface activities.

Personnel must develop hand signals with the heavy equipment operator.

A copy of the attached OSHA Job Safety poster must be prominently posted at each work site.

8.0 DECONTAMINATION

All personnel and re-usable equipment which comes into contact with potentially contaminated materials must be decontaminated prior to removal from the site. These decontamination procedures are described in the following subsections.

8.1 PERSONNEL DECONTAMINATION REQUIREMENTS

Exclusion Zone Crew: Prior to leaving the exclusion zone, personnel will briefly remove gross contamination from external clothing using decontamination equipment on hand. These individuals may then return to the contamination reduction zone and a thorough decontamination will be performed.

Support Crew: The support personnel will first assist the exclusion zone personnel through decontamination. The support personnel will then move through similar decontamination steps.

The decontamination of personnel and their protective clothing shall be performed in three stages:

Stage 1 includes removing contamination from reusable protective clothing with a detergent/water solution and soft bristle scrub brushes.

Stage 2 shall include removal of disposable protective clothing and double bagging for disposal. (Contaminated clothing will be drummed and left onsite for disposal by Navy personnel.)

Stage 3 shall consist of workers washing hands and face with potable water and soap each time they leave the exclusion zone.

8.2 EQUIPMENT DECONTAMINATION

Monitoring Equipment:

All monitoring equipment will, to the extent possible, be wrapped and sealed in plastic with only the controls, readouts, and intake and exhaust ports open to the atmosphere. If decontamination of monitoring equipment is required, the following procedure will be utilized:

- remove gross contamination with potable water
- potable water/liquinox light wash
- light rinse with potable water
- remove plastic covering

wipe dry immediately with disposable towels

Heavy Equipment

Excavation equipment and other heavy equipment will be decontaminated by steam cleaning following arrival on site, and after completion of each location.

Sampling Equipment

All devices or implements which actually contact the samples collected for laboratory analysis will be decontaminated after each use in accordance with the following procedure:

- remove gross contamination with potable water
- potable water/liquinox scrub
- rinse with potable water
- rinse with methanol and hexane
- rinse with deionized water, air dry
- wrap with aluminum foil (dull side toward equipment)

9.0 MEDICAL SURVEILLANCE/TRAINING REQUIREMENTS

9.1 MEDICAL SURVEILLANCE REQUIREMENTS FOR HNUS PERSONNEL

All HNUS personnel participating in project field activities will have had a physical examination meeting the requirements of HNUS' medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances can be obtained from the HNUS HSO.

9.2 MEDICAL SURVEILLANCE REQUIREMENTS FOR SUBCONTRACTORS

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" (Figure 9-1) must be used to satisfy this requirement providing it is properly completed and signed by a licensed physician.

9.3 TRAINING REQUIREMENTS FOR HALLIBURTON NUS PERSONNEL

All HNUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the FTA - Site 11 in Brunswick, Maine. Additionally, HNUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. Supervisory training is required of any onsite personnel directly responsible for, or who supervise, employees working onsite.

Documentation of HNUS introductory, refresher and supervisory training can be obtained through the HSO. Copies of certificates or other official documentation will be used to fulfill this requirement.

9.4 TRAINING REQUIREMENTS FOR SUBCONTRACTORS

All HNUS subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing work at the FTA - Site 11 in Brunswick, Maine. Additionally, supervisory training is required of any onsite personnel directly responsible for, or who supervise, employees working onsite. HNUS subcontractors must certify that each employee has had such training by sending HNUS a letter, on

FIGURE 9-1
SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of

Company Name

Participant Name: _____

Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -

- ☐ qualified to perform work at the FTA - Site 11 work site
☐ not qualified to perform work at the FTA - Site 11 work site

and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and found to be medically -

- ☐ qualified to wear respiratory protection
☐ not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

- ☐ A copy of OSHA Standard 29 CFR 1910.120 and appendices.
☐ A description of the employee's duties as they relate to the employee's exposures.
☐ A list of known/suspected contaminants and their concentrations (if known).
☐ A description of any personal protective equipment used or to be used.
☐ Information from previous medical examinations of the employee which is not readily available to the examining physician.

Part B

I, _____, have examined _____
Name (print) Participant's Name (print)
and have determined the following information:

Physician's

FIGURE 9-1
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests as they pertain to site work (excluding finding or diagnoses unrelated to occupational exposure):

2. Any detected medical conditions which would place the employee at increased risk:

3. Recommended limitations upon the employee's assigned work:

I have informed this participant of the results of this medical examination and any medical conditions which require further examination or treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the FTA - Site 11 work site, this participant

- ☐ may
☐ may not

perform his/her assigned task.

FIGURE 9-1
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE THREE

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

Address

company letterhead, containing the information in the example letter provided as Figure 9-2. Copies of training certificates must also be submitted with the official letter as supporting documentation.

9.5 SITE-SPECIFIC TRAINING

HNUS will provide site-specific training to all HNUS employees and subcontractor personnel who will perform work at this project. This training will only be provided once and personnel who do not attend will not be permitted to perform work at the FTA - Site 11 work area. Site-specific training will include:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on-site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of the health and safety plan, and addendums, if any.
- Review of relevant MSDSs

9.5.1 Site-Specific Training Documentation

HNUS and subcontractor personnel will be required to sign a statement indicating receipt of site-specific training and understanding of site hazards and control measures. Refer to Attachment A for the site-specific training document.

FIGURE 9-2
OSHA TRAINING CERTIFICATION

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Gordon Bullard
Project Manager
HALLIBURTON NUS Corporation
187 Ballardvale St. Suite A-100
Wilmington, MA 01887

Subject: Hazardous Waste Site Training

Dear Mr. Bullard:

The employees listed below have had introductory hazardous waste site training or equivalent work experience as required by 29 CFR 1910.120(e) and those employees listed below who have received their introductory training more than 12 months ago have also received 8 hours of refresher training in accordance with 29 CFR 1910.120 (e)(8). In addition, supervisory training is required of any onsite personnel directly responsible for, or who supervise, employees working onsite.

LIST FULL NAMES OF EMPLOYEES

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

10.0 EMERGENCY RESPONSE PLAN

This emergency response plan has been prepared to accommodate requirements presented in 29 CFR 1910.120. A copy of this Emergency Response Plan must remain on site at all times when work is in progress.

10.1 ANTICIPATED SITE EMERGENCIES

Compliance with this HASP can assist in the prevention of anticipated site emergencies. There are several emergencies which can reasonably be anticipated during the activities at the Site, to include:

- Personal Injury/Illness
- Incipient Stage, non-structural fires (Class A or B)
- Unwanted chemical releases/exposures

These emergency situations can easily be recognized by visual observations, worker complaints or monitoring instruments. A chemical release shall be considered an emergency when it is sufficient to affect unprotected personnel, including site workers and the public.

10.2 PERSONNEL ROLES AND LINES OF AUTHORITY

The SSO or alternate is responsible for initiating and coordinating emergency response actions during emergencies.

The Site Supervisor or alternate is responsible for assisting the SSO in notifying the appropriate outside emergency assistance, as needed, in accordance with Figure 10-1. Figure 10-2 depicts directions to the local hospital.

10.3 SAFE DISTANCES AND EVACUATION ROUTES

All support personnel will remain a minimum of 100 feet upwind of all work and sample locations. All approaches to the sampling crews will be made from the upwind direction. The SSO shall continuously monitor prevailing wind direction and advise support or response crews accordingly.

Safe distances for unprotected personnel are to be determined by the Site Supervisor/SSO on an emergency specific basis. Considerations shall include wind direction and site topography. The Site Supervisor shall post evacuation routes and meeting points, for each work area, at the site command post.

10.4 SITE SECURITY AND CONTROL

All crews will maintain observation of the area where work is being undertaken to assure that no inadvertent exposure to unauthorized and untrained personnel will occur. The contamination reduction and exclusion zones will be clearly marked to exclude unauthorized and unprotected persons from these areas.

A daily visitors log will be maintained to assure that all workers are accounted for during emergency response actions.

10.5 RESPONSE PROCEDURES

The information provided in this subsection is presented as a guideline to assist the Site Supervisor and SSO in safe and effective response to anticipated site emergencies. This information is in no way designed to take the place of reasonable decisions based on incident-specific information.

First Priority

Prevent further injury or illness by:

- Protecting response personnel
- Isolating the scene to authorized personnel only
- Rescuing the injured parties
- Notifying Outside Emergency Assistance

Second Priority

Provide first-aid to those persons with life threatening injuries or illnesses.

Third Priority

Alleviate the immediate hazards by:

- Extinguishing incipient stage fires
- Reducing chemical releases

Fourth Priority

Provide first-aid to those persons with non-life threatening injuries or illnesses and further efforts to alleviate the hazard.

Last Priority

Complete an incident report, critique the response and prevent recurrence. All persons with known or suspected chemically related injuries or illnesses shall be immediately examined by a licensed physician. The examining physician may choose to consult with the HALLIBURTON NUS medical consultant for additional expertise on occupational injury/illness.

10.6 EMERGENCY EQUIPMENT

This section provides guidelines for maintaining and selecting the appropriate PPE and emergency equipment for response to anticipated site emergencies.

Incipient Stage, Non-structural Fires (Class A or B)

Class A,B,C Fire Extinguisher.

Approach from up-wind side.

No special PPE required unless fire has moved out of its incipient stage to an uncontrolled burn or if upwind approach is not possible. In either of these cases, do not attempt to extinguish the flames.

Personal Injury or Illness

First-aid kit, eyewash station

10.7 EMERGENCY REPORTING

Emergency reporting functions shall be the responsibility of the Site Supervisor. The Site Supervisor will become thoroughly familiar with this plan prior to the initiation of any site work activities.

In the event that an emergency incident occurs and offsite response assistance is necessary, the Site Supervisor shall contact the appropriate agency(s) presented in Figure 10-1.

FIGURE 10-1

EMERGENCY REFERENCE INFORMATION

AMBULANCE	911
POLICE	911
FIRE DEPARTMENT	911
NEAREST PHONE	Cellular Phone (508) 989-3702
*PROJECT MANAGER	Gordon Bullard (508) 658-7899
*SSO	Janet Pillion (508) 658-7899
ALTERNATE SSO	TBA

EMERGENCY CONTACTS (Medical & Health)

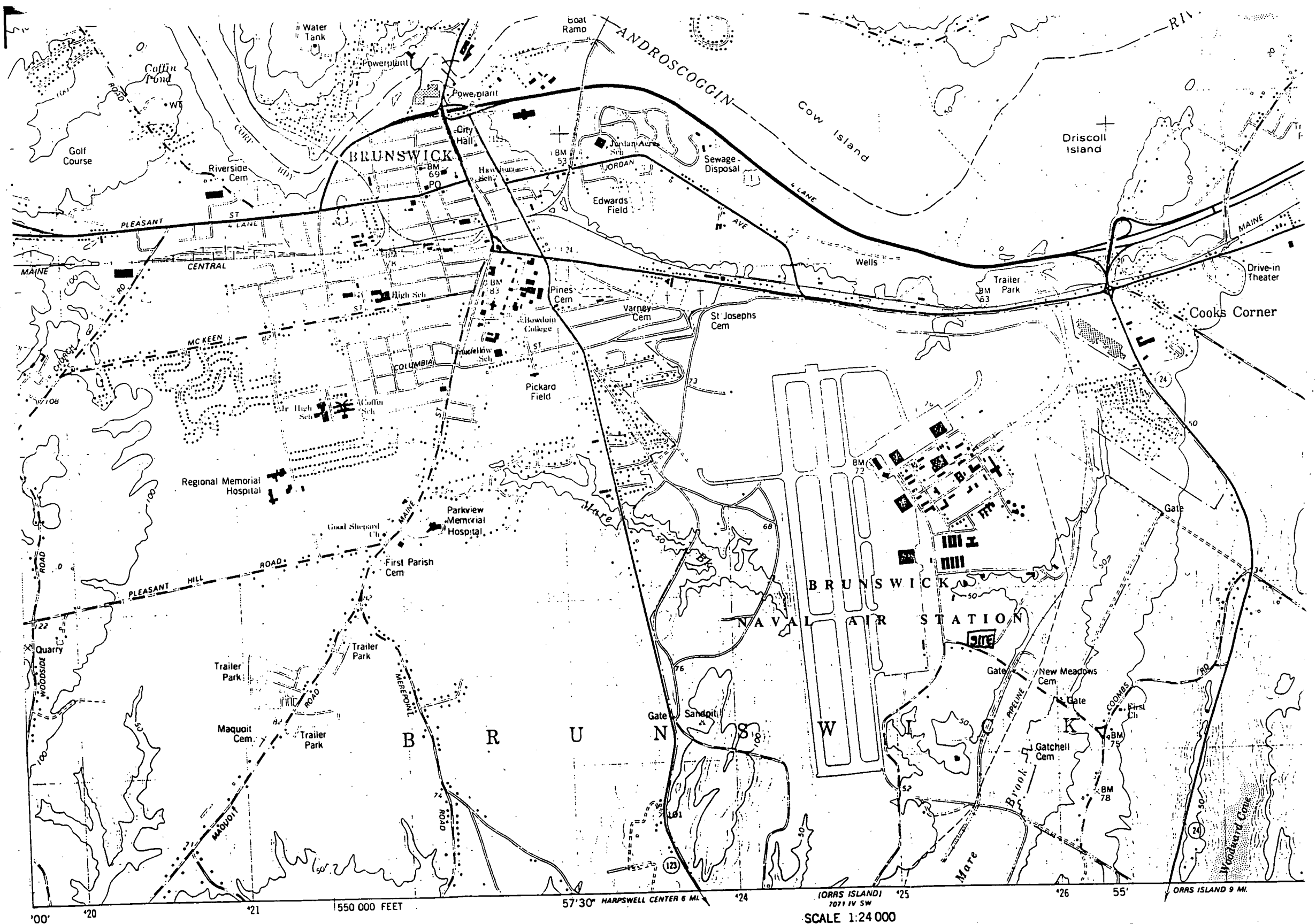
HALLIBURTON NUS Consulting Physician:	Health Resources
Office:	(617) 935-8581
CLEAN Health & Safety Manager:	Matthew Soltis, CSP, CIH
Office:	(412) 921-8912
Director of Industrial Hygiene & Safety:	Tom Samson, CIH
Office:	(713) 575-4562

National Response Center (for Environmental Emergency Only): 1-800-424-8802
HALLIBURTON NUS Wilmington, MA Office: (508) 658-7899

Directions to Hospital:

Parkview Memorial Hospital
329 Maine St.
Brunswick, Maine
(207)729-1641

Directions to be determined prior to arrival onsite.



Mapped, edited, and published by the Geological Survey

Control by USGS, NOS/NOAA, and Maine Geodetic Survey
Topography by photogrammetric methods from aerial photographs taken 1972. Field checked 1974. Map edited 1980

Selected hydrographic data compiled from NOS charts 13290 (1979) and 13293 (1979). This information is not intended for navigation purposes

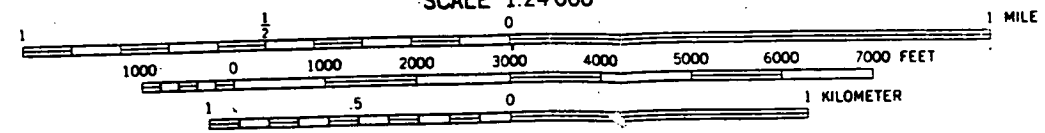
Projection and 10,000-foot grid ticks: Maine coordinate system, west zone (transverse Mercator)

1000-meter Universal Transverse Mercator grid, zone 19 1927 North American Datum

To place on the predicted North American Datum 1983 move the projection lines 4 meters south and 42 meters west as shown by dashed corner ticks

17' 302 MILS
0°39' 12 MILS

GRID AND 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



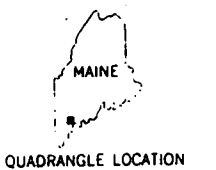
CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

DEPTH CURVES AND SOUNDINGS IN FEET--DATUM IS MEAN LOW WATER
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 4.3 FEET

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY RESTON VIRGINIA 22092

10-5



QUADRANGLE LOCATION

11.0 SPILL CONTAINMENT PROCEDURES

It is possible that during handling of the buried waste or the decontamination fluids, a spill could occur. Containers will be stored in chemically compatible pans/trays for containment. All investigation derived waste (IDW) which is drummed during site activities will remain onsite for disposal by the Navy. The Navy or their contractor will be responsible for spills or leaks during removal and transport.

The procedures defined in this section comprise the drum handling and spill prevention program in place for HNUS activities at the site.

Drums and containers used during site activities shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

Drums and containers shall be inspected and their integrity assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried, stacked behind other drums or several tiers high, etc.) shall be moved to an accessible location and inspected prior to further handling.

Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

Site operations shall be organized to minimize the amount of drum or container movement.

Prior to movement of the drums or containers, all employees involved shall be warned of the potential associated hazards.

- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent, pillows, etc.) will be stationed in the immediate area. The spill containment area must be sufficient to contain and isolate the entire volume of hazardous substances being handled.

Drums or containers that cannot be moved due to their integrity, shall be emptied into a sound container.

Fire extinguishing equipment meeting 29 CFR Part 1910, Subpart L, shall be on hand and ready if needed.

Airline connections shall be protected from contamination. The entire airline system shall be protected from physical damage.

All handling equipment and hand tools shall be of type to prevent sources of ignition.

Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums.

Material handling equipment used to transfer drums and containers shall be selected, positioned, and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

- All drums or containers removed from the test pit will be staged in a bermed area and covered. Staged drums will be periodically inspected for leaks. If leaks are observed, the drum will be replaced into an approved container and the spilled material will immediately be cleared.

12.0 OTHER MISCELLANEOUS REQUIREMENTS

Materials and Document

The HNUS Site Supervisor shall ensure the following materials/documents are taken to the project site and utilized as required.

- Incident Reports
- Material Safety Data Sheets for decontamination solutions and other substances brought to the site
- Follow-Up Reports (to be completed by the SSO)
- OSHA Job Safety and Health Poster (posted in site trailer)
- Site-specific Training Documentation Form
- First Aid Supply Usage Form
- Emergency Reference Posting

HASP ATTACHMENT A

HASP REVIEW FORM

My signature below indicates that I am aware of the potential hazardous nature of performing activities at the former Fire Training Area (FTA) - Site 11 located in Brunswick, Maine and that I have reviewed the Health and Safety Plan prepared for the Removal Action/Disposal activities. I have also received site-specific training which included the items presented below:

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

[illegible]

HASP ATTACHMENT B
MATERIAL SAFETY DATA SHEETS

CERTIFIED SPECIFICATIONS and MATERIAL SAFETY DATA SHEET

11/08/89

Last revised June 1989

SECTION I PRODUCT SPECIFICATIONS

Q. F790 Acetone
CAS NO. 67-64-1 Other name: 2-Propanone
Supplied by CHEM SERVICE, Inc. PO BOX 3108, WEST CHESTER, PA, 19381 (215)692-3026
EMERGENCY PHONE #: 215-386-2100

Lot No. 22-129B Purity 99.5% Certified by Ze
This is to certify that analysis of this sample was made by various chromatographic, spectral and thermal methods. The procedures used are considered to be STATE OF THE ART. CHEM SERVICE, Inc. guarantees purity of unopened bottles until expiration on the bottle.

SECTION II TOXICITY DATA

RAT OR MOUSE LD50	RTECSH	OSHA PEL	ACGIH TLV
7400mg/kg	AL3150000	1000 ppm(2400 mg/m3)	750 ppm(1780 mg/m3)

This compound is generally considered to be non-toxic.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY	EVAPORATION RATE (Butyl acetate=1)
24 C	56.5 C	0.788	181mm@20 C	2	5.6
ODOR	COLOR	PHASE			SOLUBILITY IN WATER
Fruity/Pleasant	Colorless	Liquid			Miscible with

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: -18 C This is a flammable chemical.
EXTINGUISHING MEDIA: Carbon dioxide or dry chemical powder. DO NOT USE WATER!
UPPER EXPLOSION LIMIT: 12.8% LOWER EXPLOSION LIMIT: 2.6%

SECTION V HEALTH HAZARD DATA

Contact lenses should not be worn in the laboratory.
All chemicals should be considered hazardous - Avoid direct physical contact!
Can be harmful if inhaled. Can be harmful if swallowed.
Prolonged exposure may cause nausea/headache/dizziness and/or eye damage. Can cause eye irritation.
Can cause skin irritation. Dust and/or vapors can cause irritation to respiratory tract.
Can be irritating to mucous membranes. Vapors and/or direct eye contact can cause severe eye burns.
Repeated exposure to vapors and/or dust can cause eye injury.
Vapors can cause severe eye inflammation and swelling of adjoining tissues.
Narcotic at high concentrations. Can cause an allergic respiratory reaction.
Can cause an allergic skin reaction. Can cause sensitization by skin contact.
Can cause general feeling of disorientation. Can cause convulsions. Can be fatal if inhaled!
Can cause liver injury. Can cause kidney injury. Can cause gastro-intestinal disturbances.

SECTION VI FIRST AID

An antidote is a substance intended to counteract the effect of a poison. It should be administered only by a physician or a trained emergency personnel. Medical advice can be obtained from a POISON CONTROL CENTER.

In case of contact: Flush eyes continuously with water for 15-20 minutes. Flush skin with water for 15-20 minutes. If no burns have occurred-use soap and water to cleanse skin.
 If inhaled remove patient to fresh air. Administer oxygen if patient is having difficulty breathing. If patient has stopped breathing administer artificial respirations.
 If patient is in cardiac arrest administer CPR.
 Continue life supporting measures until medical assistance has arrived.
 Remove and wash contaminated clothing.
 If patient is exhibiting signs of shock - Keep warm and quiet.
 Contact Poison Control Center immediately if necessary. Induce vomiting if swallowed.
 If swallowed give syrup of ipecac.
 Do not administer liquids or induce vomiting to an unconscious or convulsing person.
 If patient is vomiting-watch closely to make sure airway does not become obstructed by vomit.
 Get medical attention if necessary.

SECTION VII REACTIVITY DATA

Flammable. Decomposition liberates toxic fumes. Sensitive to heat.
 Incompatible with strong oxidizing agents. Readily absorbed and retained on clothing and/or shoes.
 Incompatible with strong bases. Incompatible with strong reducing agents. Decomposed by moisture.
 Air sensitive. Volatile. Incompatible with strong acids. Explosive.

SECTION VIII SPILL OR LEAK PROCEDURES

Spills or leaks: Evacuate area. Wear appropriate OSHA regulated equipment. Ventilate area.
 Absorb on vermiculite or similar material. Sweep up and place in an appropriate container. Hold for disposal. Wash contaminated surfaces to remove any residues.
DISPOSAL: Burn in a chemical incinerator equipped with an afterburner and scrubber.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

This chemical should be handled only in a hood. Eye shields should be worn. Use appropriate OSHA/MSHA approved safety equipment. Avoid contact with skin, eyes and clothing. Keep tightly closed in a cool dry place. Store only with compatible chemicals.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

The above information is believed to be correct on the date it is published and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded MSDS must be made available to the employee within three months. Responsibility for updates lies with the employer and not with CHEM SERVICE, Inc. Persons not specifically and properly trained should not handle this chemical or its container. This MSDS is provided without any warranty expressed or implied, including merchantability or fitness for any particular purpose.

This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticidal products, food additives or as household chemicals.

HASP ATTACHMENT C

OSHA POSTER

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory civil penalties against employers of up to \$7,000 for each serious violation and for optional penalties of up to \$7,000 for each nonserious violation. Penalties of up to \$7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$70,000 for each such violation. A minimum penalty of \$5,000 may be imposed for each willful violation. A violation of posting requirements can bring a penalty of up to \$7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to \$250,000 (or \$500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of \$10,000 or up to six months in jail or both.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State Labor or Health department or a State university.

Posting Instructions

Employers in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, GA	(404) 347-3573
Boston, MA	(617) 565-7164
Chicago, IL	(312) 353-2220
Dallas, TX	(214) 767-4731
Denver, CO	(303) 844-3061
Kansas City, MO	(816) 426-5861
New York, NY	(212) 337-2378
Philadelphia, PA	(215) 596-1201
San Francisco, CA	(415) 744-6670
Seattle, WA	(206) 442-5930

Lynn Martin

Lynn Martin, Secretary of Labor

U.S. Department of Labor

Occupational Safety and Health Administration

Washington, DC
1991 (Reprinted)
OSHA 2203



To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

HASP ATTACHMENT D

HEAT/COLD STRESS MONITORING

HEAT/COLD STRESS MONITORING

HEAT STRESS MONITORING

The heat stress monitoring program will be managed on-site by the SSO. Monitoring will be based on heat stress monitoring.

Heat Stress Symptoms

Heat stroke is always life-threatening. The person's temperature control system that causes sweating stops working correctly. The body temperature rises so high that brain damage and death will result if the person is not cooled quickly. The main signs of heat stroke are red or flushed skin; hot, dry skin, although the person may have been sweating earlier; and extremely high body temperature, often to 41°C (106°F). There may be dizziness, nausea, headache, rapid pulse and unconsciousness.

Heat exhaustion is much less dangerous than heat stroke. The major signs of heat exhaustion are pale, clammy skin, profuse perspiration, and extreme tiredness or weakness. The body temperature is approximately normal. The person may have a headache and may vomit.

Cool a victim of heat stroke quickly. If the body temperature is not brought down fast, permanent brain damage or death may result. Soak the person in cool but not cold water, sponge the body with rubbing alcohol or cool water, or pour water on the body to reduce the temperature to a safe level, about 39°C (102°F). Then stop cooling and observe the victim for 10 minutes. Call an ambulance as soon as possible. If the temperature starts to rise again, cool the victim again. Do not give coffee, tea, or alcoholic beverages.

For mild heat exhaustion, stop work, remove the protective coveralls and get out of the sun. Give the person water, juice, or Gatorade. Medical care is needed for severe heat exhaustion.

Of particular importance is heat stress resulting when protective clothing decreases natural body ventilation. One or more of the following will help reduce heat stress:

1. Drinking water shall be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup, every 15-20 minutes (about 150 ml or 1/2 pint).

The water shall be kept reasonably cool (55-60°F) and shall be placed close to the workplace so that the worker can reach it without abandoning the work area. However, where contaminants are known/suspected to exist that pose an ingestion toxicity hazard potential, workers shall not be permitted to consume any fluids without first being decontaminated and going to a noncontaminated area.

2. Long cotton underwear acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing. It should be the minimum undergarment worn.
3. When necessary/applicable, install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.
4. In the extremely hot weather, conduct non-emergency response operations in the early morning or evening.
5. In hot weather, rotate shifts of workers wearing impervious clothing.
6. Good hygienic standards must be maintained by frequent changes of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.
7. Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during their first week of exposure to hot environmental conditions. The work-rest regimen in this procedure is valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically unfit workers must be exposed to heat stress conditions.
8. Provide a shaded rest area.

Heat Stress Monitoring

In the event that heat stress/heat exhaustion is observed during work activities, the on-site HALLIBURTON NUS representative determines that the type of work may require careful monitoring, or environmental conditions dictate careful monitoring (e.g., respirators, plastic tyvek, and heavy workload) the following procedures could be implemented.

Work-Rest Regimen

Establishment of a proper work-rest regimen may be used in conjunction with the work load required to perform each task. Light work examples include sitting or standing to control machines or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing or use of coated coveralls and respirators. Heavy work corresponds to pick and shovel-type work or the use of full body protective clothing. It must be assumed that any activity involving this type of clothing will be considered heavy work.

The work-rest regimen selected will be utilized as a baseline. The actual or adjusted period of work will be determined based on the biological monitoring outlined in the biological monitoring section.

Biological Monitoring

One of the following procedures shall be followed when the work-place temperature is 70°F or above, and/or upon this site HSO's discretion, in order to make sure the work/rest regime is providing proper personal protection and to document exposure.

1. Heart rate (HR) shall be measured by the pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/min. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of rest period stays the same. If the pulse rate is 100 beats/min at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.
2. Body temperature shall be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7°F at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent. The worker's OT should be measured at the end of the rest period to make sure that it has dropped below 99°F. At no time shall work begin with OT above 99°F.

HEAT STRESS PREVENTION WORK-REST REGIMENT GUIDELINES
(Values Are Given in 0°F WBGT)

Work Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous Work	86.0	80.0	77.0
75% Work - 25% Rest Each Hour	87.0	82.0	78.6
50% Work - 50% Rest Each Hour	89.0	85.0	82.0
25% Work - 75% Rest Each Hour	90.0	88.0	86.0

COLD STRESS MONITORING

Persons working outdoors in temperatures at or below freezing may experience frostbite. Extreme cold for a short time may cause severe injury to the surface of the body. Areas of the body that have a high surface area to volume ratio, such as fingers, toes, and ears, are the most susceptible.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill (Table 1, Attachment A) is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 mph is equivalent in chilling effect to still air at - 18°F.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed, if the clothing underneath is soaked with perspiration.

Frostbite

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

1. Frost nip or incident frostbite - the conditions are characterized by sudden blanching or whitening of skin.
2. Superficial frostbite - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
3. Deep frostbite - tissues are cold, pale, and solid; extremely serious injury.

Hypothermia

Authorities agree that there are degrees of hypothermia which are characterized as "moderate" and "severe". A victim of moderate hypothermia, who may exhibit the first seven signs listed below, is still conscious but often confused. Severe hypothermia is determined by extreme skin coldness; loss of consciousness; faint pulse; and shallow, infrequent, or apparently absent respiration. Death is the ultimate result.

Practically, the onset of severe shivering signals danger to personnel. Exposure to cold shall be immediately terminated for any severely shivering worker.

Signs of Hypothermia

1. Severe shivering
2. Abnormal behavior
3. Slowing
4. Stumbling
5. Weakness
6. Repeated falling
7. Inability to walk
8. Collapse
9. Stupor
10. Unconsciousness

Cold Stress Emergency Action

1. Remove the victim from the hypothermia-/frostbite-producing environment.
2. Seek expert medical help immediately.
3. Reduce handling to a minimum. Do not rub or massage the victim.
4. Prevent further body heat loss by covering the victim lightly with blankets. Plastic may be used for further insulation. Do not cover the victim's face.
5. If the victim is still conscious, administer hot drinks. Encourage activity, such as walking while wrapped in a blanket. Do not administer any form of sedative, tranquilizer, or analgesic (pain reliever), because these may facilitate further heat loss and convert moderate hypothermia into a severe case.

Cold Stress Work-Place Monitoring

Work-place monitoring is required as follows:

1. A thermometer accurate to 1°F shall be assigned at any workplace where the environmental temperature is known or expected to be below 60°F to enable overall compliance with the requirements of this procedure.
2. Whenever the air temperature at a work place falls to 30°F or below, the dry-bulb temperature and wind speed shall be measured and recorded at least every 4 work-hours.
3. The equivalent chill temperature (ECT) shall be obtained (in all cases where air movement measurements are required) and shall be recorded with the other data in the site log, together with a record of the length of time spent working and resting.

Personal Protective Equipment Requirements for Cold Environments

Since prolonged exposure to cold air can lead to dangerous hypothermia, whole body protection must be provided as follows:

Adequate insulating clothing, to maintain core temperatures above 97°F, must be provided to workers if work is performed in air temperatures below 40°F. Wind chill or the cooling power of the air is a critical factor.

As wind speed increases and work area temperature decreases, the insulation values of the workers' protective clothing must increase. The equivalent chill temperature must be used when estimating the combined cooling effects of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

ATTACHMENT B

HALLIBURTON NUS STANDARD OPERATING PROCEDURES



NUS
CORPORATION

ENVIRONMENTAL
MANAGEMENT GROUP

STANDARD OPERATING PROCEDURES

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Revision
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Applicability
EMG

Prepared
Earth Sciences

Approved
D. Senovich

Subject
SAMPLE PRESERVATION

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1.0 PURPOSE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped offsite for chemical analysis.

2.0 SCOPE

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, while many organic chemicals may dissolve various types of plastic containers. It is therefore critical to select the correct container in order to maintain the quality of the sample prior to analysis.

Many water and soil samples are unstable, and therefore require preservation when the time interval between field collection and laboratory analysis is long enough to produce changes in either the concentration or the physical condition of the constituent(s) requiring analysis. While complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected.

Preservation techniques are usually limited to pH control, chemical addition(s) and refrigeration/freezing. Their purpose is to (1) retard biological activity, (2) retard hydrolysis of chemical compounds/complexes, (3) reduce constituent volatility, and (4) reduce adsorption effects.

3.0 GLOSSARY

HCl - Hydrochloric Acid
H₂SO₄ - Sulfuric Acid
HNO₃ - Nitric Acid
NaOH - Sodium Hydroxide

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing one gram-atom of replaceable hydrogen or its equivalent. Thus, a one molar solution of HCl, containing one gram-atom of H, is "one-normal," while a one molar solution of H₂SO₄ containing two gram-atoms of H, is "two-normal."

4.0 RESPONSIBILITIES

Field Operations Leader - retains overall responsibility for the proper storage and preservation of samples. During the actual collection of samples, the sampling technician(s) will be directly responsible for the bottling, preservation, labeling, and custody of the samples they collect until released to another party for storage or transport to the analytical laboratory.

5.0 PROCEDURES

5.1 SAMPLE CONTAINERS

For most samples and analytical parameters either glass or plastic containers are satisfactory. In general, if the analyte(s) to be determined is organic in nature, the container shall be made of glass. If the analyte(s) is inorganic, then the container shall be plastic. Since container specification will depend on the analyte and sample matrix types (as indicated in Attachment A) duplicate samples shall be taken when both organic and inorganic analyses are required. Containers shall be kept in the

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dark (to minimize biological or photooxidation/photolysis breakdown of constituent) until they reach the analytical laboratory. The sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample is heated during transport (1 liter of water at 4°C expands by 15 ml if heated to 130°F/55°C), however, head space for volatile organic analyses shall be omitted.

For CLP laboratories, containers will be obtained through the CLP Sample Management Office. For Responsible party actions or non-CLP laboratories, the laboratory shall provide containers that have been cleaned according to U.S. EPA procedures. Sufficient lead time shall be allowed. Shipping containers for samples, consisting of sturdy ice chests, are provided by the laboratory of the remedial investigation contractor.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded; because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or missing Teflon liner (if required for the container) shall be discarded.

General sample container and sample volume requirements are listed in Attachment A. Specific container requirements are listed in Attachment B.

5.2 PRESERVATION TECHNIQUES

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the Field or added in the Field. In general, aqueous samples of low concentration organics (or soil samples of low or medium concentration organics) are cooled to 4°C. Medium concentration aqueous samples and high hazard organics sample are not preserved. Low concentration aqueous samples for metals are acidified with HNO₃, while medium concentration and high hazard aqueous metal samples are not preserved. Low or medium concentration soil samples for metals are cooled to 4°C while high hazard samples are not preserved.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

5.2.1 Addition of Acid (H₂SO₄, HCl, or HNO₃) or Base

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade and shall be diluted to the required concentration with double-distilled, deionized water in the laboratory, before Field sampling commences:

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Acid Base	Concentration	Normality	Amount for Acidification*
HCl	1:1 dilution of concentrated HCl	6N	5-10 ml
H ₂ SO ₄	1:1 dilution of concentrated H ₂ SO ₄	18N	2-5 ml
HNO ₃	Undiluted concentrated HNO ₃	16N	2-5 ml
NaOH	400 grams solid NaOH in 870 ml water	10N	2 ml**

* Amount of acid to add (at the specified strength) per liter of water to reduce the sample pH to less than 2, assuming that the water is initially at pH 7, and is poorly buffered and does not contain particulate matter.

** To raise pH of 1 liter of water to 12.

The approximate volumes needed to acidify one liter of neutral water to a pH of less than 2 (or raise the pH to 12) are shown in the last column of the above table. These volumes are only approximate; if the water is more alkaline, contains inorganic or organic buffers, or contains suspended particles, more acid may be required. The final pH must be checked using narrow-range pH paper.

Sample acidification or base addition shall proceed as follows:

- Check initial pH of sample with wide range (0-14) pH paper.
- Fill sample bottle to within 5-10 ml of final desired volume and add about 1/2 of estimated acid or base required, stir gently and check pH with medium range pH paper (pH 0-6 or pH 7.5-14, respectively).

Add acid or base a few drops at a time while stirring gently. Check for final pH using narrow range (0-2.5 or 11-13, respectively) pH paper; when desired pH is reached, cap sample bottle and seal.

Never dip pH paper into the sample; apply a drop of sample to the pH paper using the stirring rod.

5.2.2 Cyanide Preservation

Pre-sample preservation is required if oxidizing agents such as chlorine are suspected to be present. To test for oxidizing agents, place a drop of the sample on KI-starch paper; a blue color indicates the need for treatment. Add ascorbic acid to the sample, a few crystals at a time, until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume. Add NaOH solution to raise pH to greater than 12 as described in 5.2.1. If oxidizing agents are not suspected, add NaOH as directed.

5.2.3 Sulfide Preservation

Samples for sulfide analysis must be preserved by addition of 4 drops (0.2 ml) of 2N zinc acetate solution per 100 ml sample. The sample pH is then raised to 9 using NaOH. The 2N zinc acetate solution is made by dissolving 220 g of zinc acetate in 870 ml of distilled water to make 1 liter of solution.

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5.2.4 Preservation of Organic Samples Containing Residual Chlorine

Some organic samples containing residual chlorine must be treated to remove this chlorine upon collection (See Attachment A). Test the samples for residual chlorine using EPA methods 330.4 or 330.5 (Field Test Kits are available for this purpose). If residual chlorine is present, add 0.008% sodium thiosulfate (80 mg per liter of sample).

5.2.5 Field Filtration

When the objective is to determine concentration of dissolved inorganic constituents in a water system, the sample must be filtered through a non-metallic 0.45 micron membrane filter immediately after collection. A filtration system is recommended if large quantities of samples must be filtered in the field. The filtration system shall consist of a Büchner funnel inserted into a single-hole rubber stopper, sized to form a seal when inserted into the top of a vacuum filter flask equipped with a single side arm. Heavy-wall Tygon tubing shall be attached to the single side arm of the vacuum filter flask and the suction port of a vacuum pump. The stem of the Büchner funnel shall extend below the level of the side arm of the vacuum filter flask to prevent any solvent from entering the tubing leading to the vacuum pump. Before filtration, the filter paper, which shall be of a size to lay flat on the funnel plate, shall be wetted with the solvent in order to "seal" it to the funnel. Slowly pour the solvent into the funnel and monitor the amount of solvent entering the vacuum filter flask. When the rate of solvent entering the flask is reduced to intermittent dripping and the added aliquot of solvent in the funnel has passed through the filter, the used filter paper shall be replaced with new filter paper. If the solvent contains a high percentage of suspended solids, a coarser-sized nonmetallic membrane filter may be used prior to usage of the 0.45 micron membrane filter. This "prefiltering" step may be necessary to expedite the filtration procedure. Discard the first 20 to 50 ml of filtrate from each sample to rinse the filter and filtration apparatus to minimize the risk of altering the composition of the samples by the filtering operation. For analysis of dissolved metals, the filtrate is collected in a suitable bottle (see Section 5.1) and is immediately acidified to pH 2.0 or less with nitric acid whose purity is consistent with the measurement to be made. Inorganic anionic constituents may be determined using a portion of the filtrate that has not been acidified.

Samples used for determining temperature, dissolved oxygen, Eh, and pH should not be filtered. Do not use vacuum filtering prior to determining carbonate and bicarbonate concentration because it removes dissolved carbon dioxide and exposes the sample to the atmosphere. Pressure filtration can be done using water pressure from the well. If gas pressure is required, use an inert gas such as argon or nitrogen.

Do not filter samples for analysis of volatile organic compounds. If samples are to be filtered for analyzing other dissolved organic constituents, use a glass-fiber or metal-membrane filter and collect the samples in a suitable container (see Section 5.1). Because most organic analyses require extraction of the entire sample, do not discard any of it. After filtering, the membrane containing the suspended fraction can be sealed in a glass container and analyzed separately as soon as practicable. Total recoverable inorganic constituents may be determined using a second, unfiltered sample collected at the same time as the sample for dissolved constituents.

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6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater. 15th Edition. APHA, Washington, D.C.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. U.S. EPA-EMSL, Cincinnati, Ohio.

7.0 ATTACHMENTS

Attachment A - General Sample Container and Preservation Requirements CERCLA/RCRA Samples

Attachment B - Required Containers, Preservation Techniques, and Holding Times (3 sheets)

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ATTACHMENT A
GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS CERCLA/RCRA SAMPLESFT-7.06
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SAMPLE TYPE & CONCENTRATION		CONTAINER ¹	SAMPLE SIZE	PRESERVATION ²	HOLDING TIME ²
<u>WATER</u>					
Organics (GC & GC/MS)	VOA	borosilicate glass	2 x 40 ml	Cool to 4°C	7 days
	<u>Extractables</u>				
	Low	amber glass	2 x 2 l or 4 x 1 l	Cool to 4°C	5 days to extraction 40 days after extraction
	Medium	wide-mouth glass	4 x 32 oz	None	Same as above
Inorganics	<u>Metals</u>				
	Low	high density (h.d.) polyethylene	1 l	HNO ₃ to pH ≤2	6 months (Hg-30 days)
	Medium	wide-mouth glass	16 oz	None	6 months
	<u>Cyanide</u>				
	Low	h.d. polyethylene	1 l	NaOH to pH >12	14 days
	Medium	wide-mouth glass	16 oz	None	
Organic/Inorganic	High Hazard	8 oz wide-mouth glass	6 oz	None	14 days
COD	--	h.d. polyethylene	0.5 l	H ₂ SO ₄ to pH <2	28 days
TOC	--	h.d. polyethylene	0.5 l	HCl to pH <2	28 days
Oil & Grease	--	glass	1.0 l	H ₂ SO ₄ to pH <2	28 days
Phenols	--	h.d. polyethylene	1.0 l	H ₂ SO ₄ to pH <2	28 days
General Chemistry	--	h.d. polyethylene	1.0 l	None	---
<u>SOIL</u>					
Organics (GC & GC/MS)	VOA	2 x 120 ml (4 oz) wide-mouth glass	240 ml	Cool to 4°C	10 days
	<u>Extractables</u>				
	Low/Medium	8 oz or 2 x 4 oz (120 ml) wide-mouth glass	6 oz	Cool to 4°C	10 days to extraction 40 days after extraction
Inorganics	Low/Medium	8 oz or 2 x 4 oz (120 ml) wide-mouth glass	6 oz	Cool to 4°C	NA
Organic/Inorganic	High Hazard	8 oz (120 ml) wide-mouth glass	6 oz	None	NA
Dioxin	All	4 oz (120 ml) wide-mouth glass	4 oz	None	NA
EP Toxicity	All	250 ml h.d. polyethylene	200 grams	None	NA
<u>Air</u>					
Volatile Organics	Low	Charcoal Tube	100 l air	Cool to 4°C	NA
	Medium	7 cm long, 6 mm OD, 4 mm ID			

1. All glass containers should have Teflon cap liners or septa.
2. See Attachment B.

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS CERCLA/RCRA SAMPLES

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ATTACHMENT B
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

PAGE 1

Parameter No./Name	Container ⁽¹⁾	Preservation ^(2,3)	Maximum Holding Time ⁽⁴⁾
INORGANIC TESTS:			
Acidity	P,C	Cool, 4°C	14 days
Alkalinity	P,C	Cool, 4°C	14 days
Ammonia	P,C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Biochemical Oxygen Demand	P,C	Cool, 4°C	48 hours
Bromide	P,C	None required	28 days
Biochemical Oxygen Demand, Carbonaceous	P,C	Cool, 4°C	48 hours
Chemical Oxygen Demand	P,C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Chloride	P,C	None required	28 days
Chlorine, Total Residual	P,C	None required	Analyze immediately
Color	P,C	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P,C	Cool, 4°C, NaOH to pH 12, 0.6g ascorbic acid ⁽³⁾	14 days ⁽⁶⁾
Fluoride	P	None required	28 days
Hardness	P,C	HNO ₃ to pH 2, H ₂ SO ₄ to pH 2	6 months
Hydrogen Ion (pH)	P,C	None required	Analyze immediately
Kjeldahl and Organic Nitrogen	P,C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Nitrate	P,C	Cool, 4°C	48 hours
Nitrate-Nitrite	P,C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Nitrite	P,C	Cool, 4°C	48 hours
Oil and Grease	C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Organic Carbon	P,C	Cool, 4°C, HCl or H ₂ SO ₄ to pH 2	28 days
Orthophosphate	P,C	Filter immediately, Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	C Bottle and top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	C Bottle and top	Fix on site and store in dark	8 hours
Phenols	C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Phosphorus (elemental)	P,C	Cool, 4°C, H ₂ SO ₄ to pH 2	28 days
Phosphorus, Total	P,C	Cool, 4°C	7 days
Residue, Total	P,C	Cool, 4°C	48 hours
Residue, Filterable	P,C	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P,C	Cool, 4°C	48 hours
Residue, Settlingable	P,C	Cool, 4°C	7 days
Residue, Volatile	P,C	Cool, 4°C	28 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P,C	Cool, 4°C	28 days
Sulfate	P,C	Cool, 4°C	7 days
Sulfide	P,C	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH 9	Analyze immediately
Sulfite	P,C	None required	48 hours
Surfactants	P,C	Cool, 4°C	Analyze immediately
Temperature	P,C	None required	48 hours
Turbidity	P,C	Cool, 4°C	
METALS:⁽⁷⁾			
Chromium VI	P,C	Cool, 4°C	24 hours
Mercury	P,C	HNO ₃ to pH 2	28 days
Metals, except Chromium VI and Mercury	P,C	HNO ₃ to pH 2	6 months

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ATTACHMENT B
REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

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Parameter No./Name	Container (1)	Preservation (2,3)	Maximum Holding Time (4)
ORGANIC TESTS: (8)			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5)	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5) HCl to pH 2(5)	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5) adjust pH to 4-5(10)	14 days
Phenols(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5)	7 days until extraction, 40 days after extraction(11)
Benzidines(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5)	7 days until extraction
Phthalate Esters(11)	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitrosamines(11,14)	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008X Na ₂ S ₂ O ₃ (5)	7 days until extraction, 40 days after extraction
PCBs(11) Acrylonitrile	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitroaromatics and Isophorone(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5), store in dark	7 days until extraction, 40 days after extraction
Polynuclear Aromatic Hydrocarbons(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5), store in dark	7 days until extraction, 40 days after extraction
Halothere(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5)	7 days until extraction, 40 days after extraction
Chlorinated Hydrocarbons(11)	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
TCDD(11)	G, Teflon-lined cap	Cool, 4°C, 0.008X Na ₂ S ₂ O ₃ (5)	7 days until extraction, 40 days after extraction
PESTICIDES TESTS:			
Pesticides(11)	G, Teflon-lined cap	Cool, 4°C, pH 5-9(15)	7 days until extraction, 40 days after extraction
RADIOLOGICAL TESTS:			
1-3 Alpha, beta and radium	P, G	KNO ₃ to pH 2	6 months

TABLE 1 Notes

(1) Polyethylene (P) or Glass (G).

(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

(3) When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).

(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and will be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator.

(5) Should only be used in the presence of residual chlorine.

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ATTACHMENT B

REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

PAGE 3

(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

(7) Samples should be filtered immediately on-site before adding preservative for dissolved metals.

(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

(9) Sample receiving no pH adjustment must be analyzed within seven days of sampling.

(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.0081 sodium thiosulfate, storing in the dark, and adjusting the pH to 8-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of bensidine).

(12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to bensidine.

(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

(14) For the analysis of diphenylnitroamine add 0.0081 Na₂S₂O₃ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.0081 Na₂S₂O₃.



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Revision
1

Applicability
EMG

Prepared
Earth Sciences

Approved
D. Senovich

Subject
DECONTAMINATION OF CHEMICAL SAMPLING
AND FIELD ANALYTICAL EQUIPMENT

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1.0 PURPOSE

The purpose of these procedures is to provide a general methodology, protocol, and reference information on the proper decontamination procedures to be used on chemical sampling and field analytical equipment.

2.0 SCOPE

This procedure addresses chemical sampling and field analytical equipment only, and should be consulted when equipment decontamination procedures are being developed as part of project-specific plans.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Manager - responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with these guidelines.

Field Operations Leader - responsible for ensuring that decontamination procedures for all chemical sampling and field analytical equipment are programmed prior to the actual field effort and that personnel required to accomplish the task have been briefed and trained to execute the task.

5.0 PROCEDURES

In order to assure that chemical analysis results are reflective of the actual concentrations present at sampling locations, chemical sampling and field analysis equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e., between sample points) and at the conclusion of the sampling program. This will minimize the potential for cross-contamination between sample points and the transfer of contamination offsite.

This procedure incorporates only those aspects of decontamination not addressed in other procedures. Specifically it incorporates those items involved in decontamination of chemical sampling and field analytical equipment.

5.1 ACCESS FOR SAMPLING

5.1.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points via the use of common bailer, or its attached line, is high unless strict procedures for decontamination are followed. It is preferable, for the aforementioned reason, to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures should be followed.

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Before the initial sampling and after each succeeding sampling point, the bailer must be decontaminated. The following steps should be followed if sampling for organic contaminants:

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush may be required if the sample point is heavily contaminated with heavy or extremely viscous compounds
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse
- Acetone or methanol rinse
- Hexane rinse**
- Distilled/Deionized water rinse
- Air dry

If sampling for organics only, the nitric acid, acetone, methanol, and hexane rinses may be omitted. Contract-specific requirements may permit alternative procedures.

Braided nylon or polypropylene lines may be used with a bailer, however, the same line must not come in contact with the sample medium, otherwise, the line must be discarded in an approved receptacle and replaced. Prior to use, the bailer should be wrapped in aluminum foil or polyethylene sheeting.

5.1.2 Sampling Pumps

Most sampling pumps are normally low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except the 10 percent nitric acid solution is omitted. Each of the liquid fractions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics into the water being sampled (especially the phthalate esters) or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (in order of preference). Whenever possible, dedicated hoses should be used.

* Due to the leaching ability of nitric acid, on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb; or the sampling equipment is dedicated.

** If sampling for pesticides, PCBs, or fuels.

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5.1.3 Filtering Equipment

Part of the sampling plan may incorporate the filtering of groundwater samples, and subsequent preservation. This should occur as soon after sample retrieval as possible; preferably in the field as soon as the sample is obtained. To this end, three basic filtration systems are most commonly used - the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

5.2 FIELD ANALYTICAL EQUIPMENT

5.2.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water
- Acetone or methanol rinse
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.2.2 Probes

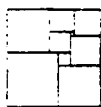
Probes, e.g., pH or specific ion electrodes, geophysical probes, or thermometers which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise; in those cases, the methods of decontamination must be clearly described in the FSAP. Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, e.g., OVA equipment, the probe will be wiped with clean paper-towels or cloth wetted with alcohol.

6.0 REFERENCES

None.

7.0 RECORDS

None.



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Subject

SOIL AND ROCK SAMPLING

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1.0 PURPOSE

The purpose of this procedure is to identify the equipment, sequence of events, and appropriate methods necessary to obtain soil, both surface and subsurface, and rock samples during field sampling activities.

2.0 SCOPE

The methods described within this procedure are applicable while collecting surface and subsurface soil samples; obtaining rock core samples for lithologic and hydrogeologic evaluation; excavation/foundation design and related civil engineering purposes.

3.0 GLOSSARY

Hand Auger- A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches O.D. and 18 to 54 inches long. A stationary piston device may be included in the sampler to reduce sampling disturbance and increase sample recovery.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split spoon sampler (used for performing Standard Penetration Tests) is 2 inches outside diameter (OD) and 1-3/8 inches inside diameter (ID). This standard spoon typically is available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. These split-spoon samplers range in size from 2-inch O.D. to 3-1/2-inch O.D., depending upon manufacturer. The larger sizes are commonly used when a larger volume of material is required.

Rock Coring - A method in which a continuous solid cylindrical sample of rock or compact rock-like soil is obtained by the use of a double tube core barrel that is equipped with an appropriate diamond-studded drill bit which is advanced with a hydraulic rotary drilling machine.

Wire-Line Coring - As an alternate for conventional coring, this is valuable in deep hole drilling, since this method eliminates trips in and out of the hole with the coring equipment. With this technique the core barrel becomes an integral part of the drill rod string. The drill rod serves as both a coring device and casing.

4.0 RESPONSIBILITIES

Field Operations Leader - Responsible for overall management of field activities and ensuring that the appropriate sampling procedures are being implemented.

Site Geologist - The site geologist directly oversees the sampling procedures, classifies soil and rock samples, and directs the packaging and shipping of soil samples. Such duties may also be performed by geotechnical engineers, field technicians, or other qualified field personnel.

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5.0 PROCEDURES

5.1 SUBSURFACE SOIL SAMPLES

Subsurface soil samples are used to characterize subsurface stratigraphy. This characterization can indicate the potential for migration of chemical contaminants in the subsurface. In addition, definition of the actual migration of contaminants can be obtained through chemical analysis of the soil samples. Where the remedial activities may include in-situ treatment or the excavation and removal of the contaminated soil, the depth and areal extent of contamination must be known as accurately as possible.

Engineering and physical properties of soil may also be of interest should site construction activities be planned. Soil types, grain size distribution, shear strength, compressibility, permeability, plasticity, unit weight, and moisture content are some of the physical characteristics that may be determined for soil samples.

Penetration tests are also described in this procedure. The tests can be used to estimate various physical and engineering parameters such as relative density, unconfined compressive strength, and consolidation characteristics of soils.

The procedures described here are representative of a larger number of possible drilling and sampling techniques. The choice of techniques is based on a large number of variables such as cost, DQOs, local geology, etc. The final choice of methods must be made with the assistance of drilling subcontractors familiar with the local geologic conditions. Alternative techniques must be based upon the underlying principles of quality assurance implicit in the following procedures.

5.1.1 Equipment

The following equipment is used for subsurface soil sampling and test boring:

- Drilling equipment, provided by subcontractor.
- Split barrel (split spoon) samplers, OD 2 inches, ID 1-3/8 inches, either 20-inch or 26 inches long. Larger O.D. samplers are available if a larger volume of sample is needed. A common size is 3-inch O.D. (2-1/2-inch I.D.).
- Thin walled tubes (Shelby), O.D. 2 to 5 inches, 18 to 54 inches long.
- Drive weight assembly, 140-lb. (± 2 lb.) weight, driving head and guide permitting free fall of 30 inches (± 1 inch).
- Drive weight assembly, 300-lb. (± 2 lb.) weight, driving head and guide permitting free fall of 18 inches (± 1 inch).
- Accessory equipment, including labels, logbook, paraffin, and sample jars.

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5.1.2 Split Barrel (Split Spoon) Sampling (ASTM D1586-84)

The following method will be used for split barrel sampling:

- Clean out the borehole to the desired sampling depth using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts, withdraw the drill bit slowly to prevent loosening of the soil around the hole and maintain the water level in the hole at or above groundwater level.
- Side-discharge bits are permissible. A bottom-discharge bit shall not be used. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. Where casing is used, it may not be driven below the sampling elevation.
- Install the split barrel sampler and sampling rods into the boring to the desired sampling depth. After seating the sampler by means of a single hammer blow, three 6-inch increments shall be marked on the sampling rod so that the progress of the sampler can be monitored.
- The 2-inch OD split barrel sampler shall be driven with blows from a 140-lb. (± 2 lb.) hammer falling 30 inches (± 1 inch) until either a total of 50 blows have been applied during any one of the three 6-inch increments, a total of 100 blows have been applied, there is no observed advance of the sampler for 10 successive hammer blows, or until the sampler has advanced 18 inches without reaching any of the blow count limitation constraints described herein. This process is referred to as the Standard Penetration Test.

A 300-lb. weight falling 18 inches is sometimes used to drive a 2-1/2-inch or 3-inch O.D. spoon sampler. This procedure is used where dense materials are encountered or when a large volume of sample is required. However, this method does not conform the ASTM specifications.

- Repeat this operation at intervals not greater than 5 feet in homogeneous strata, or as specified in the sampling plan.
- Record the number of blows required to effect each 6 inches of penetration or fraction thereof. The first 6 inches is considered to be seating drive. The sum of the number of blows required for the second and third 6 inches of penetration is termed the penetration resistance, N . If the sampler is driven less than 18 inches, the penetration resistance is that for the last 1 foot penetrated.
- Bring the sampler to the surface and remove both ends and one half of the split barrel so that the soil recovered rests in the remaining half of the barrel. Describe carefully the sample interval, recovery (length), composition, structure, consistency, color, condition, etc., of the recovered soil then put a representative portion of each sample into a jar, without ramming. Jars with samples not taken for chemical analysis shall be sealed with wax, or hermetically sealed (using a teflon cap liner) to prevent evaporation of the soil moisture, if the sample is to be later evaluated for moisture content. Affix labels to the jar and complete Chain-of-Custody and other required sample data forms. Protect samples against extreme temperature changes and breakage by placing them in appropriate cartons stored in a protected area. Pertinent data which shall be noted on the label or written on the jar lid for each sample includes the project number, boring number, sample number, depth interval, blow counts, and date of sampling.

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- An addition to the sampler mentioned above is an internal liner, which is split longitudinally and has a thin-wall brass, steel, or paper liner inserted inside, which will preserve the sample. However, since the development of the thin-walled samplers (mentioned below) the split barrel sampler with liner has declined in use.

5.1.3 Thin Walled Tube (Shelby Tube) Sampling (ASTM D1587-83)

When it is desired to take undisturbed samples of soil, thin-walled seamless tube samplers (Shelby tubes) will be used. The following method will be used:

- Clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated materials, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and maintain the water level in the hole at or above groundwater level.
- The use of bottom discharge bits or jetting through an open-tube sampler to clean out the hole shall not be allowed. Any side discharge bits are permitted.
- A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler in the hole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the sampling rods from pushing the sample out of the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
- To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they are more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at the groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
- Upon removal of the sampler tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Newspaper or other types of filler must be placed in voids at either end of the sampler prior to sealing with wax. Place plastic caps on the ends of the sampler, tape in the caps place, and dip the ends in wax.
- Affix labels to the tubes as required and record sample number, depth, penetration, and recovery length on the label. Mark the same information and "up" direction on the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms. Do not allow tubes to freeze and store the samples vertically (with the same orientation they had in the ground, i.e., top of sample is up) in a cool place out of the

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sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Denison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs and therefore their use shall be weighed against the increased cost and the need for an undisturbed sample. In any case, if a sample cannot be obtained with a tube sampler, an attempt shall be made with a split barrel sampler at the same depth so that at least a sample can be obtained for classification purposes.

5.1.4 Continuous Core Soil Samples

The CME continuous sample tube system provides a method of sampling soil continuously during hollow stem augering. The 5-foot sample barrel fits within the lead auger of a hollow auger column. The sampling system can be used with a wide range of I.D. hollow stem augers (from 3-1/4-inch to 8-1/4-inch I.D.). This method has been used to sample many different materials such as glacial drift, hard clays and shales, mine tailings, etc. This method is particularly used when SPT samples are not required and a large volume of material is needed. Also, this method is useful when a visual description of the subsurface lithology is required.

5.2 SURFACE SOIL SAMPLES

For loosely packed earth or waste pile samples, stainless steel scoops or trowels can be used to collect representative samples. For densely packed soils or deeper soil samples, a hand or power soil auger may be used.

The following methods are to be used:

- Use a soil auger for deep samples (6 to 24 inches) or a scoop or trowel for surface samples. Remove debris, rocks, twigs, and vegetation before collection of soil. Mark the location with a numbered stake if possible and locate sample points on a sketch of the site.
- Use a new or freshly-decontaminated sampler for each sample taken. Attach a label and identification tag. Record all required information in the field logbook and on the sample log sheet, Chain-of-Custody record, and other required forms.

Pack and ship accordingly.

When a representative composited sample is to be prepared (e.g., samples taken from a gridded area or from several different depths), it is best to composite individual samples in the laboratory where they can be more precisely composited on a weight or volume basis. If this is not possible, the individual samples (all of equal volume, i.e., the sample bottles shall be full) shall be placed in a decontaminated stainless steel bucket, mixed thoroughly using a stainless steel spatula or trowel, and a composite sample collected.

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5.3 WASTE PILE SAMPLES

The use of stainless steel scoops or trowels to obtain small discrete samples of homogeneous waste piles is usually sufficient for most conditions. Layered (nonhomogeneous) piles require the use of tube samplers to obtain cross-sectional samples.

- Collect small, equal portions of the waste from several points around the pile, penetrating it as far as practical. Use numbered stakes, if possible, to mark the sampling locations and locate sampling points on the site sketch.
- Place the waste sample in a glass container. Attach a label and identification tag. Record all the required information in the field logbook and on the sample log sheet and other required forms.

For layered, nonhomogeneous piles, grain samplers, sampling triers, or waste pile samplers must be used at several representative locations to acquire a cross-section of the pile. The basic steps to obtain each sample are

- Insert a sampler into the pile at a 0- to 45-degree angle from the horizontal to minimize spillage.
- Rotate the sampler once or twice to cut a core of waste material. Rotate the grain sampler inner tube to the open position and then shake the sampler a few times to allow the material to enter the open slits. Move the sampler into position with slots upward (grain sampler closed) and slowly withdraw from the pile.

5.4 ~~ROCK SAMPLING (CORING) (ASTM D2113-83)~~

~~Rock coring enables a detailed assessment of borehole conditions to be made, showing precisely all lithologic changes and characteristics. Because coring is an expensive drilling method, it is commonly used for shallow studies of 500 feet or less, or for specific intervals in the drill hole that require detailed logging and/or analyzing. It can, however, proceed for thousands of feet continuously, depending on the size of the drill rig. It yields better quality data than air rotary drilling, although at a substantially reduced drilling rate. Rate of drilling varies widely, depending on the characteristics of lithologies encountered, drilling methods, depth of drilling, and condition of drilling equipment. Average output in a 10-hour day ranges from 40 to over 200 feet. Downhole geophysical logging or television camera monitoring is sometimes used to complement the data generated by coring.~~

~~Borehole diameter can be drilled to various sizes, depending on the information needed. Standard sizes of core barrels (showing core diameter) and casing are shown in Attachment No. 1.~~

~~Core drilling is used when formations are too hard to be sampled by soil sampling methods and a continuous solid sample is desired. Usually, soil samples are used for overburden, and coring begins in sound bedrock. Casing is set into bedrock before coring begins to prevent loose material from entering the borehole, to prevent loss of drilling fluid, and to prevent cross contamination of aquifers.~~

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ATTACHMENT 1

STANDARD SIZES OF CORE BARRELS AND CASING

Coring bit size	Nominal *		Set size *	
	O.D.	I.D.	O.D.	I.D.
RWT	$1 \frac{5}{32}$	$\frac{3}{4}$	1.160	.735
EWT	$1 \frac{1}{2}$	$\frac{29}{32}$	1.470	.905
EX, EXL, EWG, EWM	$1 \frac{1}{2}$	$\frac{13}{16}$	1.470	.845
AWT	$1 \frac{7}{8}$	$1 \frac{9}{32}$	1.875	1.281
AX, AXL, AWG, AWM	$1 \frac{7}{8}$	$1 \frac{3}{16}$	1.875	1.185
BWT	$2 \frac{3}{8}$	$1 \frac{3}{4}$	2.345	1.750
BX, BXL, BWG, BWM	$2 \frac{3}{8}$	$1 \frac{5}{8}$	2.345	1.655
NWT	3	$2 \frac{5}{16}$	2.965	2.313
NX, NXL, NWG, NWM	3	$2 \frac{1}{8}$	2.965	2.155
HWT	$3 \frac{29}{32}$	$3 \frac{3}{16}$	3.889	3.187
HWG	$3 \frac{29}{32}$	3	3.889	3.000
$2 \frac{3}{4} \times 3 \frac{7}{8}$	$3 \frac{7}{8}$	$2 \frac{3}{4}$	3.840	2.690
$4 \times 5 \frac{1}{2}$	$5 \frac{1}{2}$	4	5.435	3.970
$6 \times 7 \frac{3}{4}$	$7 \frac{3}{4}$	6	7.655	5.970
AX Wire line <u>1/</u>	$1 \frac{7}{8}$	1	1.875	1.000
BX Wire line <u>1/</u>	$2 \frac{3}{8}$	$1 \frac{7}{16}$	2.345	1.437
NX Wire line <u>1/</u>	3	$1 \frac{15}{16}$	2.965	1.937

* All dimensions are in inches; to convert to millimeters, multiply by 25.4.
1/ Wire line dimensions and designations may vary according to manufacturer.

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Size Designations		Casing O.D., inches	Casing coupling		Casing bit, O.D., inches	Core barrel bit O.D., inches*	Drill rod O.D., inches	Approximate core diameter	
Casing; Casing coupling; Casing bits; Core barrel bits	Rod; Rod couplings		O.D., inches	I.D., inches				Normal, inches	Thinwall, inches
RX	RW	1.437	1.437	1.188	1.485	1.160	1.094	—	735
EX	E	1.812	1.812	1.500	1.875	1.470	1.313	845	905
AX	A	2.250	2.250	1.906	2.345	1.875	1.625	1.185	1.281
BX	B	2.875	2.875	2.375	2.965	2.345	1.906	1.655	1.750
NX	N	3.500	3.500	3.000	3.615	2.965	2.375	2.155	2.313
HX	HW	4.500	4.500	3.938	4.625	3.890	3.500	3.000	3.187
RW	RW	1.437	Flush joint	No coupling	1.485	1.160	1.094	—	735
EW	EW	1.812			1.875	1.470	1.375	845	905
AW	AW	2.250			2.345	1.875	1.750	1.185	1.281
BW	BW	2.875			2.965	2.345	2.125	1.655	1.750
NW	NW	3.500			3.615	2.965	2.625	2.155	2.313
HW	HW	4.500			4.625	3.890	3.500	3.000	3.187
PW	—	5.500			5.650	—	—	—	—
SW	—	6.625			6.790	—	—	—	—
UW	—	7.625			7.800	—	—	—	—
ZW	—	8.625			8.810	—	—	—	—
—	AX $\frac{1}{2}$	—	—	—	—	1.875	1.750	1.000	—
—	BX $\frac{1}{2}$	—	—	—	—	2.345	2.250	1.437	—
—	NX $\frac{1}{2}$	—	—	—	—	2.965	2.813	1.937	—

* For hole diameter approximation, assume $\frac{1}{8}$ inch larger than core barrel bit.

$\frac{1}{2}$ Wire line size designation, drill rod only, serves as both casing and drill rod. Wire line core bit, and core diameters vary slightly according to manufacturer.

NOMINAL DIMENSIONS FOR DRILL CASINGS AND ACCESSORIES. (DIAMOND CORE DRILL MANUFACTURERS ASSOCIATION). 288-D-2889.

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Drilling through bedrock is initiated by using a diamond-tipped core bit threaded to a drill rod (outer core barrel) with a rate of drilling determined by the downward pressure, rotation speed of drill rods, drilling fluid pressure in the borehole, and the characteristics of the rock (mineralogy, cementation, weathering).

5.4.1 Diamond Core Drilling

A penetration of typically less than 6 inches per 50 blows using a 140-lb. hammer dropping 30 inches with a 2-inch split spoon sampler shall be considered an indication that soil sampling methods may not be applicable and that coring may be necessary to obtain samples.

When formations are encountered that are too hard to be sampled by soil sampling methods, the following diamond core drilling procedure may be used.

- Firmly seat a casing into the bedrock or the hard material to prevent loose materials from entering the hole and to prevent the loss of drilling fluid return. Level the surface of the rock or hard material when necessary by the use of a fishtail or other bits. If the drill hole can be retained open without the casing and if cross contamination of aquifers in the unconsolidated materials is unlikely, it may be omitted.
- Begin the core drilling using a double-tube swivel-core barrel of the desired size. After drilling no more than 10 feet (3 m), remove the core barrel from the hole, and take out the core. If the core blocks the flow of the drilling fluid during drilling, remove the core barrel immediately. In soft materials, a large starting size may be specified for the coring tools; where local experience indicates satisfactory core recovery or where hard, sound materials are anticipated, a smaller size or the single-tube type may be specified and longer runs may be drilled. NX/NW size coring equipment is the most commonly used size.
- When soft materials are encountered that produce less than 50 percent recovery, stop the core drilling. If soil samples are desired, secure such samples in accordance with the procedures described in ASTM Method D 1586 (Split Barrel Sampling) or in Method D 1587 (Thin-Walled Tube Sampling) for Sampling of Soils (see Section 5.1.1 and 5.1.2). Resume diamond core drilling when refusal materials are again encountered.

Since rock structures and the occurrence of seams, fissures, cavities, and broken areas are among the most important items to be detected and described, take special care to obtain and record these features. If such broken zones or cavities prevent further advance of the boring, one of the following three steps shall be taken: (1) cement the hole; (2) ream and case; or (3) case and advance with the next smaller size core barrel, as the conditions warrant.

- In soft, seamy, or otherwise unsound rock, where core recovery may be difficult, M-design core barrels may be used. In hard, sound rock where a high percentage of core recovery is anticipated, the single-tube core barrel may be employed.

5.4.2 Rock Sample Preparation and Documentation

Once the rock coring has been completed and the core recovered, the rock core shall be carefully removed from the barrel, placed in a core tray (previously labeled "top" and "bottom" to avoid confusion), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). Each core shall be described, classified, and logged using a uniform system as presented in Procedure GH-1.5. If moisture content will be determined or if it is desirable to prevent drying (e.g.,

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to prevent shrinkage of clay formations) or oxidation of the core, the core shall be wrapped in plastic sleeves immediately after logging. Each plastic sleeve shall be labeled with indelible ink. The boring number, run number, and the footage represented in each sleeve shall be included, as well as the top and bottom of the core run.

After sampling, rock cores shall be placed in the sequence of recovery in well-constructed wooden boxes provided by the drilling contractor. Rock cores from two different borings shall not be placed in the same core box unless accepted by the Site Geologist. The core boxes shall be constructed to accommodate at least 20 linear feet of core in rows of approximately 5 feet each and shall be constructed with hinged tops secured with screws, and a latch (usually a hook and eye) to keep the top securely fastened down. Wood partitions shall be placed at the end of each core run and between rows. The depth from the surface of the boring to the top and bottom of the drill run and run number shall be marked on the wooden partitions with indelible ink. A wooden partition (wooden block) shall be placed at the end of each run with the depth of the bottom of the run written on the block. These blocks will serve to separate successive core runs and indicate depth intervals for each run. The order of placing cores shall be the same in all core boxes. Rock core shall be placed in the box so that, when the box is open, with the inside of the lid facing the observer, the top of the cored interval contained within the box is in the upper left corner of the box, and the bottom of the cored interval is in the lower right corner of the box (see Attachment 2). The top and bottom of each core obtained and its true depth shall be clearly and permanently marked on each box. The width of each row must be compatible with the core diameter to prevent lateral movement of the core in the box. Similarly, an empty space in a row shall be filled with an appropriate filler material or spacers to prevent longitudinal movement of the core in the box.

The inside and outside of the core-box lid shall be marked by indelible ink to show all pertinent data on the box's contents. At a minimum, the following information shall be included:

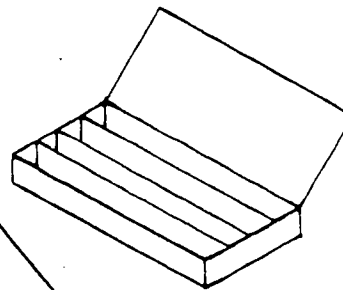
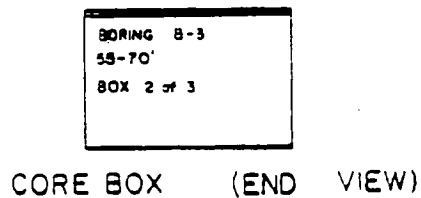
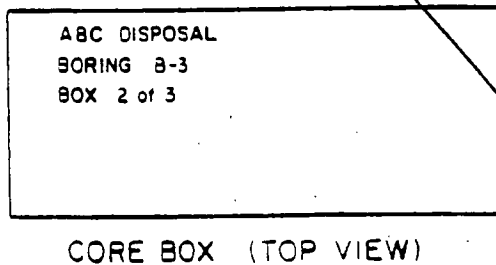
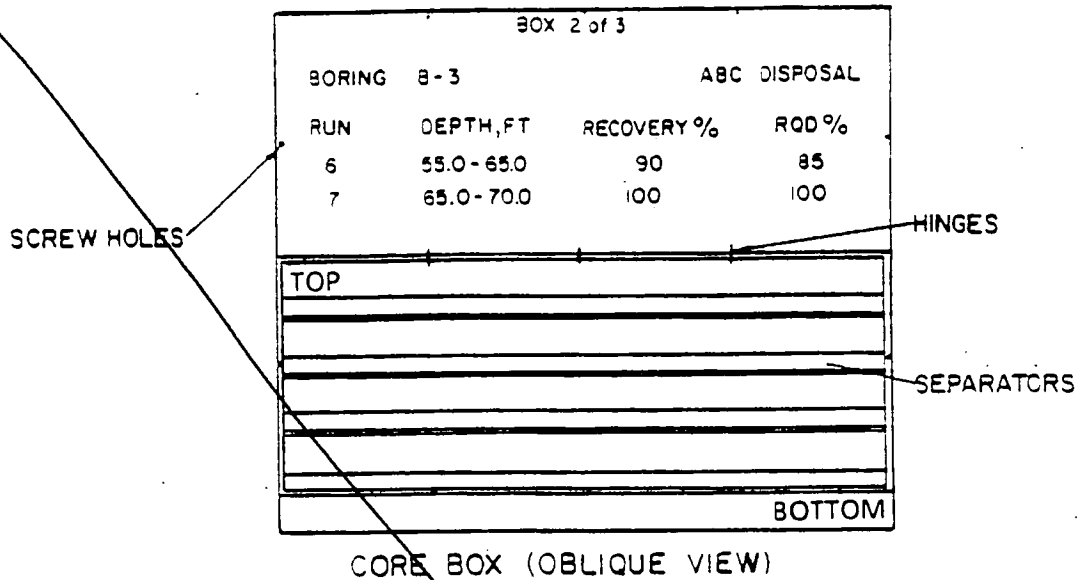
- Project name
- Project number
- Boring number
- Run numbers
- Footage (depths)
- Recovery
- RQD (%)
- Box number and total number of boxes for that boring (Example: Box 5 of 7).

For easy retrieval when core boxes are stacked, the sides and ends of the box shall also be labeled and include project number, boring number, top and bottom depths of core and box number. Attachment No. 2 illustrates a typical rock core box.

Prior to final closing of the core box, a photograph of the recovered core and the labeling on the inside cover shall be taken. If moisture content is not critical, the core shall be wetted and wiped clean for the photograph. (This will help to show true colors and bedding features in the cores).

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ATTACHMENT 2



TYPICAL ROCK CORE BOX

NOT TO SCALE



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6.0 REFERENCES

American Society for Testing and Materials, 1985. Method for Penetration Test and Split Barrel Sampling of Soils. ASTM Method D 1586-84, Annual Book of Standards, ASTM, Philadelphia, Pennsylvania.

American Society for Testing and Materials, 1985. Thin-Walled Tube Sampling of Soils. Method D-1587-83, Annual Book of Standards, ASTM, Philadelphia, Pennsylvania.

Acker Drill Co., 1958. Basic Procedures of Soil Sampling. Acker Drill Co., Scranton, Pennsylvania.

American Society for Testing and Materials, 1989. Standrd Practice for Diamond Core Drilling for Site Investigation. ASTM Method D2113-83 (reapproved 1987), Annual Book of Standards, ASTM, Philadelphia, Pennsylvania.

U.S. Department of the Interior, 1974, Earth Manual, A Water Resources Technical Publication, 810 pages.

Central Mine Equipment Company, Drilling Equipment, St. Louis, Missouri.

7.0 RECORDS

None.



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Prepared
Earth Sciences

Approved *D. Senovich*
D. Senovich

Subject

EXCAVATION OF EXPLORATORY TEST PITS AND TRENCHES

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1.0 PURPOSE

This procedure describes methods for proper excavation of test pits and trenches.

2.0 SCOPE

These procedures give overall technical guidance and may be modified by site-specific requirements for field exploratory test pits and trenches. Conditions which would make trench excavation technically difficult (such as shallow water table), potentially dangerous (presence of explosive materials or underground utilities) or likely to cause even greater environmental problems (such as potential rupture of buried containerized wastes) would require modifications to the methods described herein and may prevent implementation of the exploratory excavation program. Furthermore, the costs and difficulties in disposing of potentially hazardous materials removed from test pits may constrain their use to areas where contamination potential is low. Consequently, the techniques described herein may be most applicable in areas of low apparent contamination and where potentially explosive materials are not expected to be present.

3.0 GLOSSARY

Trenches or test pit. - Open shallow excavations, typically longitudinal (if a trench) or rectangular (if a pit), to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by a machine, such as a backhoe, clamshell, trencher excavator, or bulldozer.

4.0 RESPONSIBILITIES

Site Manager - is responsible for determining, in consultation with other project personnel (geologist, geochemist, engineer), the need for test pits or trenches, their approximate locations, depths and sampling objectives.

Field Operation Leader (FOL) - is responsible for finalizing the location and depth of test pits/trenches based on site conditions and the site geologist's advice. The FOL is ultimately responsible for the proper construction and backfilling of test pits and trenches, including adherence to OSHA regulations if applicable (see Section 5.0).

Health and Safety Officer - responsible for air quality monitoring during test pit construction and sampling, to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. He/She may also be required to advise the FOL on other safety-related matters and mitigative measures to address potential physical hazards from unstable trench walls, puncturing of drums, or other hazardous objects, etc.

Site Geologist/Sampler - responsible for recording all information and data pertaining to the test pit excavation. Engineers, field technicians, or other properly trained personnel may also serve in this capacity.

5.0 PROCEDURES

5.1 APPLICABILITY

This subsection presents routine test pit or trench excavation techniques. Specialized techniques that are applicable only under certain conditions are not presented.

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During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise and control the method of excavation. All excavations that are deeper than 4 feet must be stabilized (before entry into the excavation) by bracing the pit sides using wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, and 29 CFR 1910.134.

Excavations are generally not practical where a depth of more than about 15 feet is desired. They are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pits, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

5.2 TEST PIT AND TRENCH EXCAVATION

These procedures describe the methods for excavating and logging test pits and trenches to determine subsurface soil and rock conditions.

Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration
- The space required for efficient excavation
- The chemicals of concern
- The economics and efficiency of available equipment

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, can give a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

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Fifteen feet is considered to be the economical vertical limit of excavation. However, larger and deeper excavations have been used when special problems justified the expense.

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. It may be necessary to record several elevations for irregular or sloping surfaces. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying. For regional studies test pits and trenches may be located by survey or by using existing topographic maps and plans.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area and spoils pile will be predicated on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

The test pits and trenches shall be excavated in compliance with applicable safety regulations as specified by the health and safety officer.

If the depth exceeds 4 feet and people will be entering the pit or trench, Occupational Safety and Health Administration (OSHA) requirements must be met: Walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry. It is advisable to stay out of test pits as much as possible; if possible the required data or samples shall be gathered without entering the pit. Samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Stabilization of the sides of test pits and trenches, when required, generally is achieved by sloping the walls at a sufficiently flat angle or by using sheeting. Benching or terracing can be used for deeper holes. Shallow excavations are generally stabilized by sheeting. Test pits excavated into fill are generally much more unstable than pits dug into natural in-place soil.

Sufficient space shall be maintained between trenches or pits to place soil that will be stockpiled for cover, as well as to allow access and free movement by haul vehicles and operating equipment. Excavated soil shall be stockpiled to one side in one location, preferably downwind, away from the edge of the pit to reduce pressure on the pit walls.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific Work Plan.

The overland flow of water from excavated saturated soils and the erosion or sedimentation of the stockpiled soil shall be controlled. A temporary detention basin and a drainage system shall be planned to prevent the contaminated wastes from spreading, if necessary.

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5.3 BACKFILLING OF TRENCHES AND TEST PITS

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the logbook. All photographs shall be indexed and maintained for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the field supervisor.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the field supervisor (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.0 REFERENCES

NUS and CH₂MHill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, 1979. Excavation, Trenching and Shoring 29 CFR 1926.650-653.

7.0 RECORDS

Test pits and trenches shall be logged by the field geologist in accordance with Procedure GH-1.5.

Test pit logs shall contain a sketch of pit conditions (see Attachment A, Test Pit Log Form). In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Test pit locations shall be documented by tying in the location of two or more nearby permanent landmarks (trees, house, fence, etc.) and shall be located on a site map. Surveying may also be required, depending on the requirements of each project. Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of excavation.
- Approximate surface elevation.
- Total depth of excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

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ATTACHMENT A

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REMARKS

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SITE RADIATION SURVEYS

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1.0 PURPOSE

The purpose of this procedure is to describe the methods for performing reproducible radiological site surveys using a Geiger-Muller counter or ionization chamber. These instruments detect natural and contaminant gamma radiation emanating from surficial soils or contaminated surfaces. Depending on the construction of the detector, beta and alpha radiation may also be detectable.

2.0 SCOPE

This procedure applies in general to radiation surveys of all uncontrolled hazardous waste sites. Unless it is known with confidence that a site is not radiologically-contaminated, it must be surveyed during the site reconnaissance to establish that it is not contaminated with radioactive material. Likewise, each sample shipment should be surveyed to determine whether it needs to be labeled as "radioactive material." If a site is known to be contaminated with radioactive material based on previous site investigations, a site-specific approach may need to be developed as part of the Site Operations Plan.

3.0 GLOSSARY

Geiger-Muller Counter - A sensitive hand-held portable radiation detection instrument used to detect gamma or gamma plus beta radiation. Examples of these counters include the Ludlum Model 3, Victoreen V-490, or Eberline E-120 Survey Meters.

Ionization Chamber Counter - A relatively insensitive portable radiation detection instrument used mainly to measure high levels of gamma radiation (1 mr/hr or greater). An example of this type of counter is the Cutie Pie.

mR/hr - milliroentgens/hour. Natural background radiation dose ranges from 0.01 mR/hr to 0.03 mR/hr.

4.0 RESPONSIBILITIES

Site Manager - responsible for assuring that the Site Operations Plan is adequate with regard to radiation surveys based on known site conditions, and is in compliance with this guideline.

Health and Safety Officer - responsible for defining the need for and establishing adequate radiation protection procedures.

NUS Site Operations Group - responsible for assuring that meter calibration is current, and for checking proper meter operations and batteries before releasing equipment for field use.

Field Operations Leader - responsible for assuring proper use of the equipment and adherence to the Site Operation Plan during field operations.

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5.0 PROCEDURES

5.1 EQUIPMENT

The following equipment is required for a site radiation survey: G-M or Cutie Pie meter with current calibration sticker, 2 plastic bags, marking tape (red), stakes, hammer, site map with pre-survey grid (overlay or written directly on map), survey forms, set of spare batteries, writing pad, clip board, pens/pencils, compass.

5.2 PRE-SURVEY REQUIREMENTS

5.2.1 Survey Preparation

Check that meters have been calibrated within the specified time for recalibration. Prior to conducting the radiation survey, layout a grid (10 meter by 10 meter or as specified in the Site Operations Plan) on a map of the area to be surveyed. Label the X-axis numerically and the Y-axis alphabetically, or with another suitable system. Choose the coordinate origin at a location to prevent retracting the survey path. Note on the survey forms the grid location of obstructions or other physical features which may limit the survey or allow for a better determination of location while in the field (see Attachment A).

5.2.2 Pre-Survey Checks/Instructions

The following presents operational features of the basic type of G-M and Cutie Pie counters. Review these prior to going into the field.

1. For instruments provided with a battery check function, verify battery charge.
2. For instruments operating with two or more scale ranges, start from the upper ranges (i.e., X100 or X10) and work down to the lower ranges. Allow for at least 30 seconds before switching to the next lower scale.
3. For instruments with variable response times, (typically 5 to 25 seconds), set the response time to the mid-range. For the Ludlum Model 3, set the response to "F." This will provide 90 percent of the final meter reading in 5 seconds.
4. To prevent cross-contamination, do not place on or touch potentially contaminated ground areas or other contaminated surfaces with the meter.
5. In inclement weather conditions or to prevent contamination, a plastic bag may be slipped over the detector.
6. The meter should be held about 1 meter from the ground during the survey. For a measurement of radiation levels at a surface, the detector probe (covered with a plastic bag) may be held 10 centimeters from the surface.
7. If present, the audio switch is typically set to "off" during the survey. This prevents excessive drain on the batteries. The audio could be left on in areas suspected of having "hot spots."

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5.3 SURVEY

Upon completing the pre-survey check, turn the meter on, allow to warm up (1-5 minutes for Cutie Pie, 5-10 seconds for G-M meter), zero the Cutie Pie and proceed to the first grid point. Take a reading by starting with the high scale (e.g., X100) and working down to the lower scales. This should determine the scale for the major portion of the survey.

Allow sufficient time for the meter to settle, about 10 seconds for a Ludlum Model 3 with the response set on "F." Note the reading on the site map with grid overlay and proceed to the next grid point. Leave the meter on between grid points and note any particularly large needle deviations which may signify "hot spots."

Upon locating a "hot spot," note the reading and location. Mark the area with a peg and red marking tape. Proceed to the next grid point.

5.4 HOT SPOT SURVEYS

At the request of the Field Operations Leader, areas surrounding "hot spots" may be surveyed. The conduct of this survey will be the same as previously described using a smaller grid pattern, e.g., readings at two (2) meter intervals. The grid should be drawn as an insert to the site map and the survey readings recorded on the grid. Note that if exposure limits are exceeded, the area must immediately be cleared and the site HSO notified.

5.5 DECONTAMINATION

In addition to normal decontamination procedures, radiation survey personnel's gloves and boots should be checked when they leave the contaminated areas using a G-M meter to ensure that they are free of radiation-contaminated dust or dirt.

6.0 REFERENCES

SOP HS-3.10 - Radiation Survey Meters

SOP HS-1.02 - Decontamination

Friedlander, G., J. W. Kennedy, E. S. Macias and J. M. Miller, 1981. Nuclear and Radiochemistry, 3rd Edition, J. Wiley & Sons, New York.

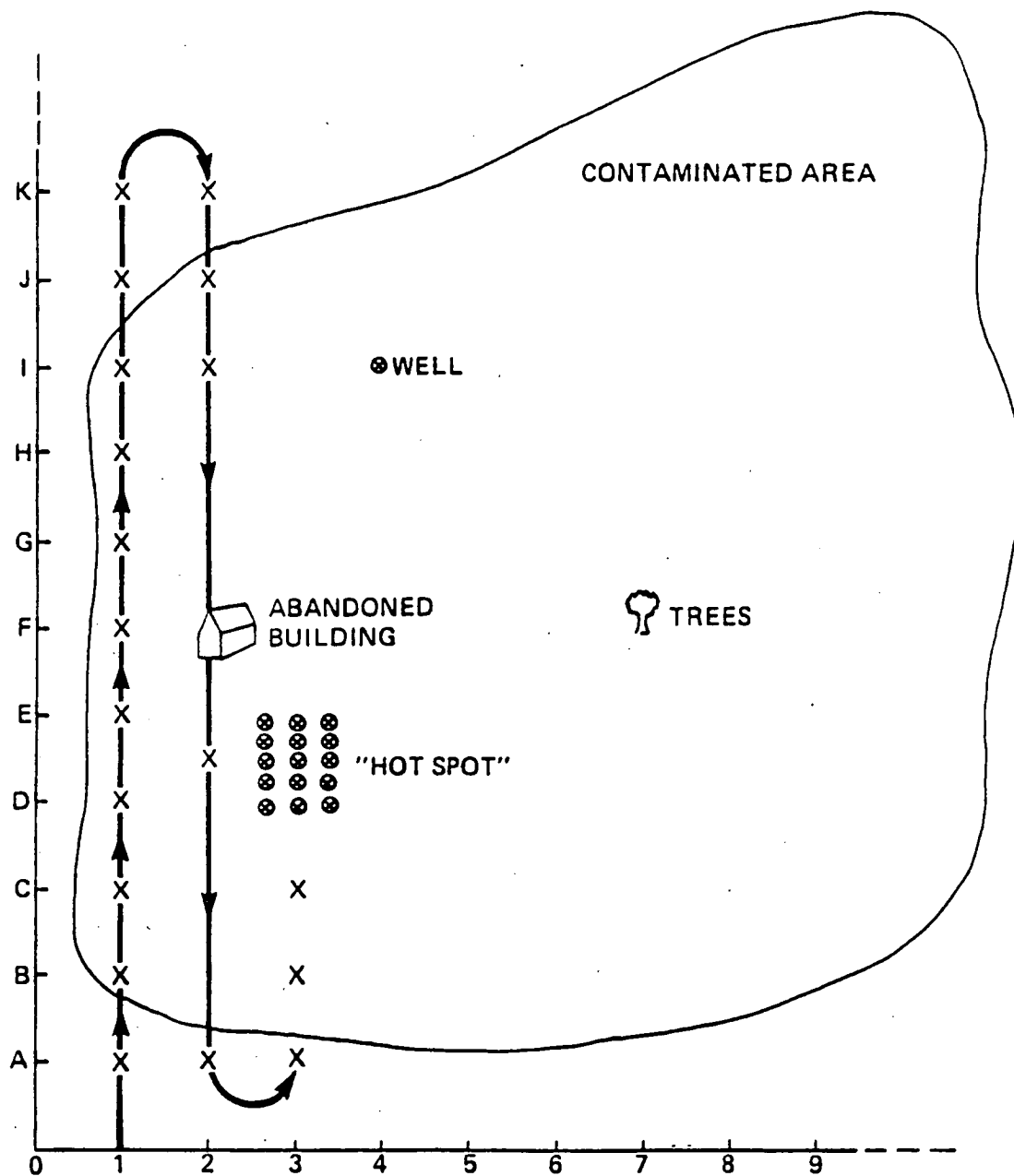
7.0 ATTACHMENTS

Attachment A - Typical layout for site radiation survey

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ATTACHMENT A

TYPICAL SITE RADIATION SURVEY LAYOUT





NUS
CORPORATION

ENVIRONMENTAL
MANAGEMENT GROUP

STANDARD OPERATING PROCEDURES

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Prepared
Earth Sciences

Approved
D. Senovich

Subject

SAMPLE IDENTIFICATION AND CHAIN-OF-CUSTODY

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1.0 PURPOSE

This purpose of this procedure is to provide information on chain-of-custody procedures to be used under the NUS Program.

2.0 SCOPE

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of all samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities. Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence. This procedure identifies the necessary custody records and describes their completion.

This procedure does not take precedence over region-specific or site-specific requirements for chain-of-custody.

3.0 GLOSSARY

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. A Chain-of-Custody Record Form is a controlled document, provided by the regional office of EPA.

The chain-of-custody form is a two-page carbon-copy type form. The original form accompanies the samples during shipment, and the pink carbon-copy is retained in the project file.

Controlled Document - A consecutively-numbered form released by EPA or Program Management Office (PMO) for use on a particular work assignment. All unused forms must be returned or accounted for at the conclusion of the assignment.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under your custody if:

- It is in your actual possession.
- It is in your view, after being in your physical possession.
- It was in your physical possession and then you locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

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4.0 RESPONSIBILITIES

Field Operations Leader - Responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record and maintaining custody of samples until they are relinquished to another custodian, to the shipper, or to the common carrier.

Remedial Investigation Leader - Responsible for determining that chain-of-custody procedures have been met by the sample shipper and analytical laboratory.

5.0 PROCEDURES

5.1 OVERVIEW

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is what it is represented to be. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom and, secondly, provide security for the evidence as it is moved and/or passes from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

5.2 SAMPLE IDENTIFICATION

The method of identification of a sample depends on the type of measurement or analysis performed. When in-situ measurements are made, the data are recorded directly in bound logbooks or other field data records, with identifying information.

5.2.1 Sample Label

Samples, other than in-situ measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling Plan. Each sample container is identified by a sample label (see Attachment B). Sample labels are provided by the PMO. The information recorded on the sample label includes:

- **Project:** EPA Work Assignment Number (can be obtained from the Sampling Plan).
- **Station Location:** The unique sample number identifying this sample (can be obtained from the Sampling Plan).
- **Date:** A six-digit number indicating the day, month, and year of sample collection; e.g., 12/21/85.
- **Time:** A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- **Medium:** Water, soil, sediment, sludge, waste, etc.

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Concentration: The expected concentration (i.e., low, medium, high).

Sample Type: Grab or composite.

- **Preservation:** Type of preservation added and pH levels.
- **Analysis:** VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- **Sampled By:** Printed name of the sampler.

Case Number: Case number assigned by the Sample Management Office.

- **Traffic Report Number:** Number obtained from the traffic report labels.

Remarks: Any pertinent additional information.

Using just the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site).

5.2.2 Sample Identification Tag

A Sample Identification Tag (Attachment F) must also be used for samples collected for CLP (Contract Laboratory Program) analysis. The Sample Identification Tag is a white, waterproof paper label, approximately 3-by-6 inches, with a reinforced eyelet, and string or wire for attachment to the neck of the sample bottle. The Sample Tag is a controlled document, and is provided by the regional EPA office. Following sample analysis, the Sample Tag is retained by the laboratory as evidence of sample receipt and analysis.

The following information is recorded on the tag:

- **Project Code:** Work Assignment Number.

Station Number: The middle portion of the Station Location Number, (between the hyphens).
- **Month/Day/Year:** Same as Date on Sample Label.

Time: Same as Time on Sample Label.
- **Designate - Comp/Grab:** Composite or grab sample.

Station Location: Same as Station Location on Sample Label.
- **Samplers:** Same as Sampled By on Sample Label.

Preservative: Yes or No.
- **Analyses:** Check appropriate box(es).

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Remarks: Same as Remarks on Sample Label (make sure the Case Number and Traffic Report numbers are recorded).

- Lab Sample Number: For laboratory use only.

The tag is then tied around the neck of the sample bottle.

If the sample is to be split, it is aliquoted into similar sample containers. Identical information is completed on the label attached to each split.

Blank, duplicate, or field spike samples shall not be identified as such on the label, as they may compromise the quality control function. Sample blanks, duplicates, spikes, and splits are defined in Procedure SA-6.6.

5.3 CHAIN-OF-CUSTODY PROCEDURES

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

5.3.1 Field Custody Procedures

- Samples are collected as described in the site-specific Sampling Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the sample log sheet and Chain-of-Custody Record exactly.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic prints shall be serially numbered, corresponding to the logbook descriptions.
- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions, e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather.

5.3.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. Chain-of-Custody Record Forms used in EPA Regions I-IV are shown in Attachments A through D. The appropriate form shall be obtained from the EPA Regional Office. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as follows:

- Enter header information (project number, samplers, and project name -- project name can be obtained from the Sampling Plan).

Sign, date, and enter the time under "Relinquished by" entry.

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- Enter station number (the station number is the middle portion of the station location number, between the hyphens).
- Check composite or grab sample.

Enter station location number (the same number as the station location on the tag and label).

- Enter the total number of containers per station number and the type of each bottle.
- Enter either the inorganic traffic report number, the organic traffic report number, or the SAS number for each station number in the remarks column.
- Enter the tag number from the bottom of the sample identification tag in the remarks column for each station location.

Make sure that the person receiving the sample signs the "Received by" entry, or enter the name of the carrier (e.g., UPS, Federal Express) under "Received by." Receiving laboratory will sign "Received for Laboratory by" on the lower line and enter the date and time.

Enter the bill-of-lading or Federal Express airbill number under "Remarks," in the bottom right corner, if appropriate.

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in the appropriate sample shipping package. Retain the pink copy with field records.

Sign and date the custody seal, a 1-by 3-inch white paper label with black lettering and an adhesive backing. Attachment G is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals are provided by ZPMO on an as-needed basis.

- Place the seal across the shipping container opening so that it would be broken if the container is opened.

Complete other carrier-required shipping papers.

The custody record is completed using black waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the sample container (enclosed with other documentation in a plastic zip-lock bag). As long as custody forms are sealed inside the sample container and the custody seals are intact, commercial carriers are not required to sign off on the custody form.

If sent by mail, the package will be registered with return receipt requested. If sent by common carrier or air freight, proper documentation must be maintained.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

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5.3.3 Receipt for Samples Form

Whenever samples are split with a private party or government agency, a separate Receipt for Samples Record Form is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the party or agency shall require the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record shall contain a statement that the samples were delivered to the designated location at the designated time. This form must be completed and a copy given to the owner, operator, or agent-in-charge even if the offer for split samples is declined. The original is retained by the Field Operations Leader.

6.0 REFERENCES

U.S. EPA, 1984. User's Guide to the Contract Laboratory Program, Office of Emergency and Remedial Response, Washington, D.C.

7.0 ATTACHMENTS

- Attachment A - Chain-of-Custody Record Form for use in Region I
- Attachment B - Chain-of-Custody Record Form for use in Region II
- Attachment C - Chain-of-Custody Record Form for use in Region III
- Attachment D - Chain-of-Custody Record Form for use in Region IV
- Attachment E - Sample Label
- Attachment F - Sample Identification Tag
- Attachment G - Chain-of-Custody Seal

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(Original is 8-1/2 by 11)

PROJECT NAME						NO. OF CON- TAINERS								REMARKS
SAMPLERS: (Signature)														
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION									

Relinquished by: (Signature)

Relinquished by: (Signature)

Relinquished by: (Signature)

Date / Time

Date / Time

Date / Time

Received by: (Signature)

Received by: (Signature)

Received for Laboratory by:
(Signature)

Relinquished by: (Signature)

Relinquished by: (Signature)

Date / Time

Date / Time

Date / Time

Received by: (Signature)

Received by: (Signature)

Remarks:

ATTACHMENT C
CHAIN-OF-CUSTODY RECORD FORM FOR USE IN REGION III
(Original is 8-1/2 x 11-3/4")

3-15966

REGION 3
Curtis Bldg., 6th & Walnut Sts.
Philadelphia, Pennsylvania 19106

[illegible]

SA-6.1

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ATTACHMENT D
CHAIN-OF-CUSTODY RECORD FORM FOR USE IN REGION IV
(Original is 8-1/2 by 14)

CHAIN OF CUSTODY RECORD

[illegible]

№ 4 3526

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**ATTACHMENT E
SAMPLE LABEL**

<input type="checkbox"/> NUS PROJECT: _____ <small>Corporation</small>	
STATION LOCATION: _____	
DATE: ____/____/____ TIME: _____ hrs.	
MEDIA: WATER <input type="checkbox"/> SOIL <input type="checkbox"/> SEDIMENT <input type="checkbox"/>	
CONCENTRATION: LOW <input type="checkbox"/> MED <input type="checkbox"/> HIGH <input type="checkbox"/>	
TYPE: GRAB <input type="checkbox"/> COMPOSITE <input type="checkbox"/>	
ANALYSIS	PRESERVATION
VOA <input type="checkbox"/> BNA's <input type="checkbox"/>	Cool to 4°C <input type="checkbox"/>
PCB's <input type="checkbox"/> PESTICIDES <input type="checkbox"/>	HNO ₃ to pH <2 <input type="checkbox"/>
METALS: TOTAL <input type="checkbox"/> DISSOLVED <input type="checkbox"/>	NAOH to pH >12 <input type="checkbox"/>
CYANIDE <input type="checkbox"/>	_____ <input type="checkbox"/>
_____ <input type="checkbox"/>	
Sampled by: _____	
Case No.: _____ Traffic Report No.: _____	
Remarks:	

ACFILE: FORMS\BOTLABL

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**ATTACHMENT F
SAMPLE IDENTIFICATION TAG**



☆ GPO 505-552





Designate:	Grab	Preservative: Yes <input type="checkbox"/> No <input type="checkbox"/>		
	Comp.			
Time	Station Location	ANALYSES		
		BOD Anions		
		Solids (TSS) (TDS) (SS)		
		COD, TOC, Nutrients		
		Phenolics		
		Mercury		
		Metals		
		Cyanide		
		Oil and Grease		
		Organics GC/MS		
		Priority Pollutants		
		Volatile Organics		
		Pesticides		
		Mutagenicity		
Bacteriology				
Project Code	Station No.	Month/Day/Year	Signatures	Remarks:
Tag No.	Lab Sample No.			
3 60966				

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



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ATTACHMENT G
CHAIN-OF-CUSTODY SEAL

_____ Signature			CUSTODY SEAL
_____ Date			_____ Date
CUSTODY SEAL			_____ Signature



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SAMPLE PACKAGING AND SHIPPING

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1.0 PURPOSE

This procedure provides instruction for sample packaging and shipping in accordance with U.S. Department of Transportation (DOT) regulations.

2.0 SCOPE

Samples collected at hazardous waste sites usually have to be transported elsewhere for analysis. This requires that the samples be appropriately preserved to prevent or minimize chemical alteration prior to analysis, and be transported to protect their integrity, as well as to protect against any detrimental effects from leakage or breakage. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by the U.S. Department of Transportation and described in the Code of Federal Regulations (49 CFR 171 through 177, in particular 172.402h, Packages Containing Samples). In general, these regulations were not intended to cover shipment of samples collected at controlled or uncontrolled hazardous waste sites or samples collected during emergency responses. However, the EPA has agreed through a memorandum of agreement to package, mark, label, and ship samples observing DOT procedures. The information presented here is for general guidance.

This procedure is applicable to all samples taken from uncontrolled hazardous substance sites for analysis at laboratories away from the site.

3.0 GLOSSARY

Carrier - A person or firm engaged in the transportation of passengers or property.

Hazardous Material - A substance or material in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce ("commerce" here to include any traffic or transportation). Defined and regulated by DOT (49 CFR 173.2) and listed in Attachment A of this guideline.

Hazardous Waste - Any substance listed in 40 CFR Subpart D (§261.20 et seq) or otherwise characterized as ignitable, corrosive, reactive, or EP toxic as specified under 40 CFR Subpart C (§261.20 et seq) that would be subject to manifest requirements specified in 40 CFR 262. Defined and regulated by EPA.

Marking - Applying the descriptive name, instruction, cautions, weight, or specification marks or combination thereof required to be placed outside containers of hazardous materials.

n.o.i. - Not otherwise indicated.

n.o.s. - Not otherwise specified.

ORM - Other regulated material.

Packaging - The assembly of one or more containers and any other components necessary to assure compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, multiunit tank car tanks.

Placard - Color-coded, pictorial sign depicting the hazard class symbol and name to be placed on all four sides of a vehicle transporting certain hazardous materials.

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Reportable Quantity (RQ) - A parenthetical note of the form "(RQ-1000/454)" following an entry in the DOT Hazardous Materials table (49 CFR 172.101) indicates the reportable quantity of the substance in pounds and kilograms. If a spill of that amount or more of the substance occurs during transit or storage, a report must be filed with DOT according to §171.15-15 concerning hazardous materials incidents reports. If the material spilled is a hazardous waste, a report must always be filed, regardless of the amount, and must include a copy of the manifest. If the RQ notation appears, it must be shown either immediately before or after the proper shipping name on the shipping paper (or manifest). Most shipping papers and manifests will have a column designated "HM" which may be used for this purpose.

4.0 RESPONSIBILITIES

Field Operations Leader or Team Sampling Leader - responsible for determining that samples are properly packaged and shipped.

Sampling Personnel - responsible for implementing the packaging and shipping requirements.

5.0 PROCEDURES

5.1 INTRODUCTION

Samples collected for shipment from a site shall be classified as either environmental or hazardous material (or waste) samples. In general, environmental samples are collected off-site (for example from streams, ponds, or wells) and are not expected to be grossly contaminated with high levels of hazardous materials. On-site samples (for example, soil, water, and materials from drums or bulk storage tanks, obviously contaminated ponds, lagoons, pools, and leachates from hazardous waste sites) are considered hazardous. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples. If there is any doubt, a sample shall be considered hazardous and shipped accordingly.
- Protect the health and safety of laboratory personnel receiving the samples. Special precautions are used at laboratories when samples other than environmental samples are received.

5.2 ENVIRONMENTAL SAMPLES

5.2.1 Packaging

Environmental samples may be packaged following the procedures outlined in Section 5.4 for samples classified as "flammable liquids" or "flammable solids." Requirements for marking, labeling, and shipping papers do not apply.

Environmental samples may also be packed without being placed inside metal cans as required for flammable liquids or solids.

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- Place sample container, properly identified and with a sealed lid, in a polyethylene bag, and seal the bag.

Place sample in a fiberboard container or metal picnic cooler which has been lined with a large polyethylene bag.

- Pack with enough noncombustible, absorbent, cushioning materials to minimize the possibility of the container breaking.

- Seal large bag.

Seal or close outside container.

5.2.2 Marking Labeling

Sample containers must have a completed sample identification tag and the outside container must be marked "Environmental Sample." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling are required.

5.2.3 Shipping Papers

No DOT shipping papers are required. However, the appropriate chain-of-custody forms must be included with the shipment.

5.2.4 Transportation

There are no DOT restrictions on mode of transportation.

5.3 DETERMINATION OF SHIPPING CLASSIFICATION FOR HAZARDOUS MATERIAL SAMPLES

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

5.3.1 Known Substances

If the substance in the sample is known or can be identified, package, mark, label and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table, 49 CFR 172.101.

Unz and Company have published the following steps to help in locating a proper shipping name from the Hazardous Materials Table, 49 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name, for example, perchloroethylene (not listed in 172.101) is also called tetrachloroethylene (listed 172.101). It may be useful to consult a chemist for all possible technical names a material can have. If your material is not listed by its technical name then.

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2. Look for the chemical family name. For example, pentyl alcohol is not listed but the chemical family name is: alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed then.
3. Look for a generic name based on end use. For example, Paint, n.o.s or Fireworks, n.o.s. If a generic name based on end use is not listed then.
4. Look for a generic family name based on end use, for example, drugs, n.o.s. or cosmetics, n.o.s. Finally, if your material is not listed by a generic family name but you suspect or know the material is hazardous because it meets the definition of one or more hazardous classes, then.
5. You will have to go to the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s, or Oxidizer, n.o.s.

5.3.2 Unknown Substances

For samples of hazardous substances of unknown content, select the appropriate transportation category according to the DOT Hazardous Materials Classification (Attachment A), a priority system of transportation categories.

The correct shipping classification for an unknown sample is selected through a process of elimination, utilizing Attachment A. Unless known or demonstrated otherwise (through the use of radiation survey instruments), the sample is considered radioactive and appropriate shipping regulations for "radioactive material" followed.

If a radioactive material is eliminated, the sample is considered to contain "Poison A" materials (Attachment B), the next classification on the list. DOT defines "Poison A" as extremely dangerous poisonous gases or liquids of such a nature that a very small amount of gas, or vapor of the liquids, mixed with air is dangerous to life. Most Poison A materials are gases or compressed gases and would not be found in drum-type containers. Liquid Poison A would be found only in closed containers; however, all samples taken from closed drums do not have to be shipped as Poison A, which provides for a "worst case" situation. Based upon information available, a judgment must be made whether a sample from a closed container is a Poison A.

If Poison A is eliminated as a shipment category, the next two classifications are "flammable" or "nonflammable" gases. Since few gas samples are collected, "flammable liquid" would be the next applicable category. With the elimination of radioactive material, Poison A, flammable gas, and nonflammable gas, the sample can be classified as flammable liquid (or solid) and shipped accordingly. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table (Attachment A). For samples containing unknown materials, categories listed below flammable liquids/solids on Attachment A are generally not used because showing that these materials are not flammable liquids (or solids) requires flashpoint testing, which may be impractical and possibly dangerous at a site. Thus, unless the sample is known to consist of materials listed as less hazardous than flammable liquid (or solid) on Attachment A, it is considered a flammable liquid (or solid) and shipped as such.

For any hazardous material shipment, utilize the shipping checklist (Attachment C) as a guideline to ensure that all sample-handling requirements are satisfied.

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5.4 PACKAGING AND SHIPPING OF SAMPLES CLASSIFIED AS FLAMMABLE LIQUID (OR SOLID)

5.4.1 Packaging

Applying the word "flammable" to a sample does not imply that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations.

1. Collect sample in the prescribed container with a nonmetallic, Teflon-lined screw cap. To prevent leakage, fill container no more than 90 percent full.
2. Complete sample label and sample identification tag and attach securely to sample container.
3. Seal container and place in 2-mil thick (or thicker) polyethylene bag, one sample per bag. Position sample identification tag so that it can be read through bag. Seal bag.
4. Place sealed bag inside metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 5.4.2, below.
5. Place one or more metal cans (or single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans with noncombustible, absorbent cushioning materials for stability during transport. Mark container as indicated in Paragraph 2 of Section 5.4.2.

5.4.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the metal can (or 1-gallon bottle):
 - Laboratory name and address.
 - "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325."

Not otherwise specified (n.o.s) is not used if the flammable liquid (or solid) is identified. Then the name of the specific material is listed before the category (for example, Acetone, Flammable Liquid), followed by its appropriate UN number found in the DOT Hazardous Materials table (49 CFR 172.101).

2. Place all information on outside shipping container as on can (or bottle), specifically:
 - Proper shipping name.
 - UN or NA number.
 - Proper label(s).
 - Addressee and sender.

Place the following labels on the outside shipping container: "Cargo Aircraft Only" and "Flammable Liquid" (or "Flammable Solid"). "Dangerous When Wet" label shall be used if the solid has not been exposed to a wet environment. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" shall also be marked on the top of the outside container, and upward-pointing arrows shall be placed on all four sides of the container.

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5.4.3 Shipping Papers

1. Use abbreviations only where specified. Complete the carrier-provided bill of lading and sign certification statement (if carrier does not provide, use standard industry form, see Attachment D). Provide the following information in the order listed (one form may be used for more than one exterior container).
 - "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325."
 - "Limited Quantity" (or "Ltd. Qty.").
 - "Cargo Aircraft Only."
 - Net weight (wt) or net volume (vol), just before or just after "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s.," by item, if more than one metal can is inside an exterior container.
 - "Laboratory Samples" (if applicable).
2. Include Chain-of-Custody Record, properly executed in outside container.
3. "Limited Quantity" of "Flammable Liquid, n.o.s." is limited to one pint per inner container. For "Flammable Solid, n.o.s.," net weight of inner container plus sample shall not exceed one pound; total package weight shall not exceed 25 pounds.

5.4.4 Transportation

1. Transport unknown hazardous substance samples classified as flammable liquids by rented or common carrier truck, railroad, or express overnight package services. Do not transport by any passenger-carrying air transport system, even if they have cargo-only aircraft. DOT regulations permit regular airline cargo-only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that only carry cargo.
2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, shall still be used.

6.0 REFERENCES

U.S. Department of Transportation, 1983. Hazardous Materials Regulations, 49 CFR 171-177.

NUS Standard Operating Procedure SA-6.1 - Sample Identification and Chain-of-Custody

NUS Standard Operating Procedure SA-1.2 - Sample Preservation

NUS Standard Operating Procedure SF-1.5 - Compatibility Testing

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7.0 ATTACHMENTS

- Attachment A - DOT Hazardous Material Classification (49 CFR 173.2)
- Attachment B - DOT List of Class "A" Poisons (49 CFR 172.101)
- Attachment C - Hazardous Materials Shipping Checklist
- Attachment D - Standard Industry Certification Form

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ATTACHMENT A

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2)

1. Radioactive material (except a limited quantity)
2. Poison A
3. Flammable gas
4. Nonflammable gas
5. Flammable liquid
6. Oxidizer
7. Flammable Solid
8. Corrosive material (liquid)
9. Poison B
10. Corrosive material (solid)
11. Irritating material
12. Combustible liquid (in containers having capacities exceeding 110 gallons [416 liters])
13. ORM-B
14. ORM-A
15. Combustible liquid (in containers having capacities of 110 gallons [416 liters] or less)
16. ORM-E

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ATTACHMENT B

DOT LIST OF CLASS "A" POISON (49 CFR 172.101)

Material	Physical State at Standard Temperature
Arsine	Gas
Bromoacetone	Liquid
Chloropicrin and methyl chloride mixture	Gas
Chloropicrin and nonflammable, nonliquefied compressed gas mixture	Gas
Cyanogen chloride	Gas (> 13.1°C)
Cyanogen gas	Gas
Gas identification set	Gas
Gelatin dynamite (H. E. Germaine)	----
Grenade (with Poison "A" gas charge)	----
Hexaethyl tetraphosphate/compressed gas mixture	Gas
Hydrocyanic (prussic) acid solution	Liquid
Hydrocyanic acid, liquefied	Gas
Insecticide (liquefied) gas containing Poison "A" or Poison "B" material	Gas
Methyldichloroarsine	Liquid
Nitric oxide	Gas
Nitrogen peroxide	Gas
Nitrogen tetroxide	Gas
Nitrogen dioxide, liquid	Gas
Parathion/compressed gas mixture	Gas
Phosgene (diphosgene)	Liquid

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ATTACHMENT C HAZARDOUS MATERIALS SHIPPING CHECKLIST

PACKAGING

1. Check DOT 172.500 table for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample, and chain-of-custody record.

SHIPPING PAPERS

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being sent using same shipping paper.
4. Be careful all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Offer driver proper placards for transporting vehicle.
8. Check that certification is signed by shipper.
9. Make certain driver signs for shipment.

RCRA MANIFEST

1. Check that approved state/federal manifests are prepared.
2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.
3. Check that destination address is correct.
4. Check that driver knows where shipment is going.
5. Check that the driver is aware of emergency procedures for spills and accidents.
6. Make certain driver signs for shipment
7. Make certain one copy of executed manifest and shipping document is retained by shipper.

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ATTACHMENT D

STANDARD INDUSTRY CERTIFICATION FORM

[illegible]



NUS
CORPORATION

ENVIRONMENTAL
MANAGEMENT GROUP

STANDARD OPERATING PROCEDURES

Number
SA-6.3

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1 of 4

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05/04/90

Revision
2

Applicability
EMG

Prepared
Earth Sciences

Approved
D. Senovich
D. Senovich

Subject

SITE LOGBOOK

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1.0 PURPOSE

This procedure describes the process for keeping a site logbook.

2.0 SCOPE

The site logbook is a controlled document which records all major on-site activities during a Remedial Investigation/Feasibility Study. At a minimum, the following activities/events shall be recorded in the site logbook:

- Arrival/departure of site visitors
- Arrival/departure of equipment
- Sample pickup (chain-of-custody form numbers, carrier, time)
- Sampling activities/sample logsheet numbers
- Start or completion of borehole/trench/monitoring well installation or sampling activities
- Health and Safety issues

The site logbook is initiated at the start of the first on-site activity (e.g., initial reconnaissance survey). Entries are made for every day that on-site activities take place which involve RI/FS contractor personnel. One current site logbook is maintained per site.

The site logbook becomes part of the permanent site file maintained in the RI contractor's office. Because information contained in the site logbook may be admitted as evidence in cost recovery or other legal proceedings, it is critical that this document be properly maintained.

3.0 GLOSSARY

Site Logbook - The logbook is a bound notebook with consecutively numbered pages that cannot be removed. Upon entry of data, the logbook requires signature by the responsible site leader (see Section 5.1).

4.0 RESPONSIBILITIES

The site logbook is issued by the Regional Manager (or his designee) to the Site Manager for the duration of the project. The Site Manager releases the site logbook to the Field Operations Leader or other person responsible for the direction of on-site activities (e.g., Reconnaissance Survey Team Leader, Sampling Team Leader). It is the responsibility of this person (or his designee) to keep the site logbook current while in his possession, and return it to the Site Manager or turn it over to another field team. Following the completion of all fieldwork, the site logbook is returned to the Site Manager for inclusion in the permanent site files.

5.0 PROCEDURES

5.1 GENERAL

The cover of each site logbook contains the following information:

- Project Name
- NUS Project Number
- RI/FS Contractor and Site Manager's Name
- Sequential Book Number

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- Start Date
- End Date

Daily entries into the logbook may contain a variety of information. At the beginning of each day the following information must be recorded:

- Date
- Start time
- Weather
- All field personnel present
- Any visitors present

During the day, a summary of all site activities and level of personal protection shall be recorded in the logbook. The information need not duplicate that recorded in other field notebooks (e.g., sample logbook, Site Geologist's notebook, Health and Safety Officer's notebook, etc.), but shall summarize the contents of these other notebooks and refer to the page locations in these notebooks for detailed information. An example of a site logbook page is shown in Attachment A.

The sample logsheet for each sample collected (see Procedure SA-6.6) must be referenced. If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the notebook and page number(s) on which they are recorded (see Attachment A).

All entries shall be made in black pen. No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook must be signed. It must also be signed by the Field Operations Leader or responsible site leader at the end of each day.

5.2 PHOTOGRAPHS

When movies, slides, or photographs are taken of a site or any monitoring location, they are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions are entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques shall be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Adequate logbook notation and receipts may be used to account for routine film processing. Once processed, the slides of photographic prints shall be serially numbered and labeled according to the logbook descriptions.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

Attachment A - Typical Site Logbook Entry

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**ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY**

START TIME: _____

DATE: _____

SITE LEADER: _____

PERSONNEL:

NUS

DRILLER

EPA

_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well _____ resumes. Rig geologist was _____ See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4 inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____ See Geologist's Notebook, No. 2, page _____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on-site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____ See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit _____ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel offsite, gate locked.

Field Operations Leader

ATTACHMENT C

HEADSPACE SCREENING PROCEDURE

JAR HEADSPACE ANALYTICAL SCREENING PROCEDURE

The following are recommended procedures for conducting analytical screening of VOC-contaminated soil utilizing a portable Photoionization Detector (PID) or Flame Ionization Detector (FID):

- (1) Half-fill two clean glass jars with the sample to be analyzed. Quickly cover each open top with one or two sheets of clean aluminum foil and subsequently apply screw caps to tightly seal the jars. Sixteen ounce (16 oz. - approximately 500 ml) soil or "mason" type jars are preferred; jars less than 8 oz. (approximately 250 ml) total capacity may not be used.
- (2) Allow headspace development for at least 10 minutes. Vigorously shake jars for 15 seconds both at the beginning and end of the headspace development period. Where ambient temperatures are below 32°F (0°C), headspace development should be within a heated vehicle or building.
- (3) Subsequent to headspace development, remove screw lid/expose foil seal. Quickly puncture foil seal with instrument sampling probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates.

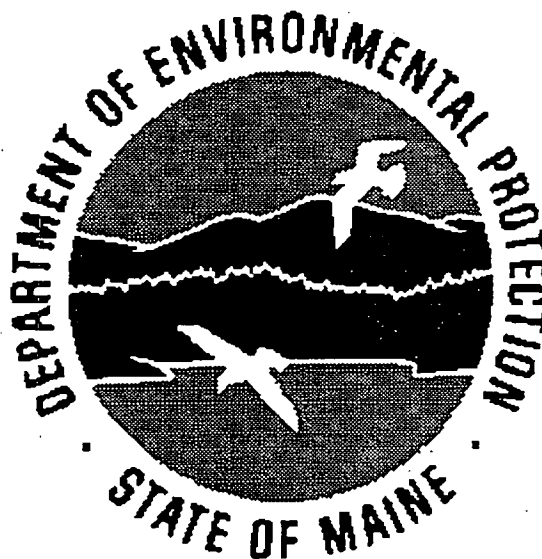
As an alternative, syringe withdrawal of a headspace sample with subsequent injection to instrument probe or septum-fitted inlet is acceptable contingent upon verification of methodology accuracy using a test gas standard.

- (4) Following probe insertion through foil seal and/or sample injection to probe, record highest meter response as the jar headspace concentration. Using foil seal/probe insertion method, maximum response should occur between 2 and 5 seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture in which case headspace data should be discounted.
- (5) The headspace screening data from both jar samples should be recorded and compared; generally, replicate values should be consistent to plus or minus 20%.

**Establishing Calibration Set Points
for Selected Photoionization Detectors (PIDs)
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April, 1994

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Abstract

The Department of Environmental Protection (DEP) approved the jar headspace method for determining petroleum content of soils at UST closure site assessments in the 1991 revision of Chapter 691. The rule required consultants to use only DEP-approved photoionization (PID) or flame-ionization (FID) instruments for headspace analysis. The DEP approved instruments on a pass-fail basis after evaluating their performance against spiked soil samples. Since 1991 consultants and DEP personnel have reported conflicting results when testing soils using different PIDs. In order to rationally compare headspace results from instrument to instrument, the DEP undertook this study to level the playing field across popular makes of PID.

To eliminate variables introduced by preparing and spiking soil samples, we used commercially-prepared headspace surrogates. A vendor of specialty gases prepared weathered gasoline and weathered #2 fuel oil surrogates in concentrations ranging from 10 to 400 ppm by weight. Manufacturers provided several copies of their latest PID model for testing.

In the first experiment, we calibrated the instruments to read 2 Methyl propene (Isobutylene) directly, then measured the concentrations of the surrogates. The instruments reported concentrations significantly different from the surrogates' certified assays. In a second experiment we determined calibration set points for each instrument/product combination, such that the instrument would directly read the product concentration. Using these set points, a third experiment determined each instrument's response to the surrogates, and linearity across a range of concentrations which bracketed the Chapter 691 notification level. In a fourth experiment we humidified the surrogates to nearly 100% R.H. to test the effect of humidity on each brand of PID.

Set points established in the second experiment worked well enough that in the third experiment the test instruments accurately reported the concentrations within a range of

variation reasonable for a field instrument. The fourth experiment demonstrated dramatic differences in the way humidity affects various makes of PID. Humidity depressed the readings from a minimum of 17 % to a maximum of 74 % using a gasoline surrogate, and 11 % to 54 % using the #2 fuel oil surrogate.

Introduction

In September 1991 the Maine Department of Environmental Protection (DEP) revised its Regulations for the Registration, Installation, Operation, and Closure of Underground Oil Storage Facilities, popularly known as "Chapter 691". Among the changes was the DEP's acceptance of a jar- and poly-bag headspace technique to determine exceedance of notification levels for soil contamination at underground tank site assessments. The regulations established headspace notification levels of 50 ppm for #2 fuel oil and 200 ppm for gasoline. Soil concentrations above these levels required DEP notification. Although DEP preferred lab analysis of the soil, the field headspace technique was simple, inexpensive, and offered "real-time" results. It was, and is, widely preferred by tank owners and petroleum marketers.

Appendix Q of Chapter 691 describes the jar- or poly-bag headspace procedure. The procedure requires an investigator to allow the subject soil to equilibrate with the air in a closed vessel for a prescribed period of time, and within a specified temperature range. The investigator then measures the headspace hydrocarbon concentration using a DEP-approved photoionization detector (PID), calibrated in accordance with its manufacturer's instructions. Sites with soil concentrations below the notification levels can be closed "clean" without further DEP involvement, and a site assessment report must be filed within 45 days. Soil exceeding the notification level triggers an immediate reporting requirement, sending the tank owner to the Leak Investigation, Response, and Corrective Action section of Chapter 691.

The procedure for using the jar- and poly-bag headspace technique considers all PIDs equal. The work leading to adoption of the technique established only that DEP-accepted devices were "sensitive enough" to produce a response in the concentration range of interest -- a pass-fail system. It was evident that different makes and models of PID gave significantly different results when measuring the same headspace. However, DEP considered establishing a response factor for each instrument beyond its capability at that time. DEP attempted to choose notification levels conservative enough to protect human health and the environment when using the least sensitive instrument.

The need to "level the playing field" across PIDs became evident within a year of Chapter 691 adoption. Investigators testing the same soil with different instruments sometimes observed results that differed by as much as an order of magnitude. DEP received anecdotal reports that certain consultants selected the instrument for a LUST investigation based on the result a client required. DEP staff were unable to meaningfully compare results obtained on different makes of PID.

Experimental Design

In earlier DEP work we measured headspace concentrations over spiked, jarred soil samples. This required obtaining a source of clean mineral soil, sieving out the oversize fraction, drying, measuring soil into jars, re-moistening to a consistent water content, and spiking neat petroleum product using a micro syringe. Each step introduced opportunity for error and inconsistency, which we attempted to overcome by using large numbers of replicates. Although these experimental results were internally consistent, we could not reproduce them in subsequent runs due to additional variables such as product spike composition and soil variability.

Headspace Surrogates

To avoid these limitations we decided to test instruments against commercially prepared gaseous mixtures of petroleum products, representative of the headspace over weathered gasoline and #2 fuel oil. We obtained samples of these products from monitoring wells at two Maine LUST sites and analyzed these using gas chromatography/mass spectrograph (GC/MS) methods. Based on this analysis, we designed a blend of substances representative of the weathered gasoline and #2 fuel oil headspaces. We will present a detailed discussion of surrogate design later in this report.

A specialty gas manufacturer supplied each blend in cylinders at concentrations of 10, 25, 50, 100, 200, and 400 ppm. The balance of gas in each cylinder was ultra-pure nitrogen to prevent degradation of the hydrocarbons. We also obtained a cylinder of ultra-zero air and cylinders of 100 and 250 ppm 2 Methyl propene (Isobutylene), the recommended span gas for most PIDs.

Test Instruments

We asked several manufacturers of PIDs to provide test instruments. Table 1 lists participating manufacturers and the models tested:

Table 1 PID Instruments Used in This Investigation

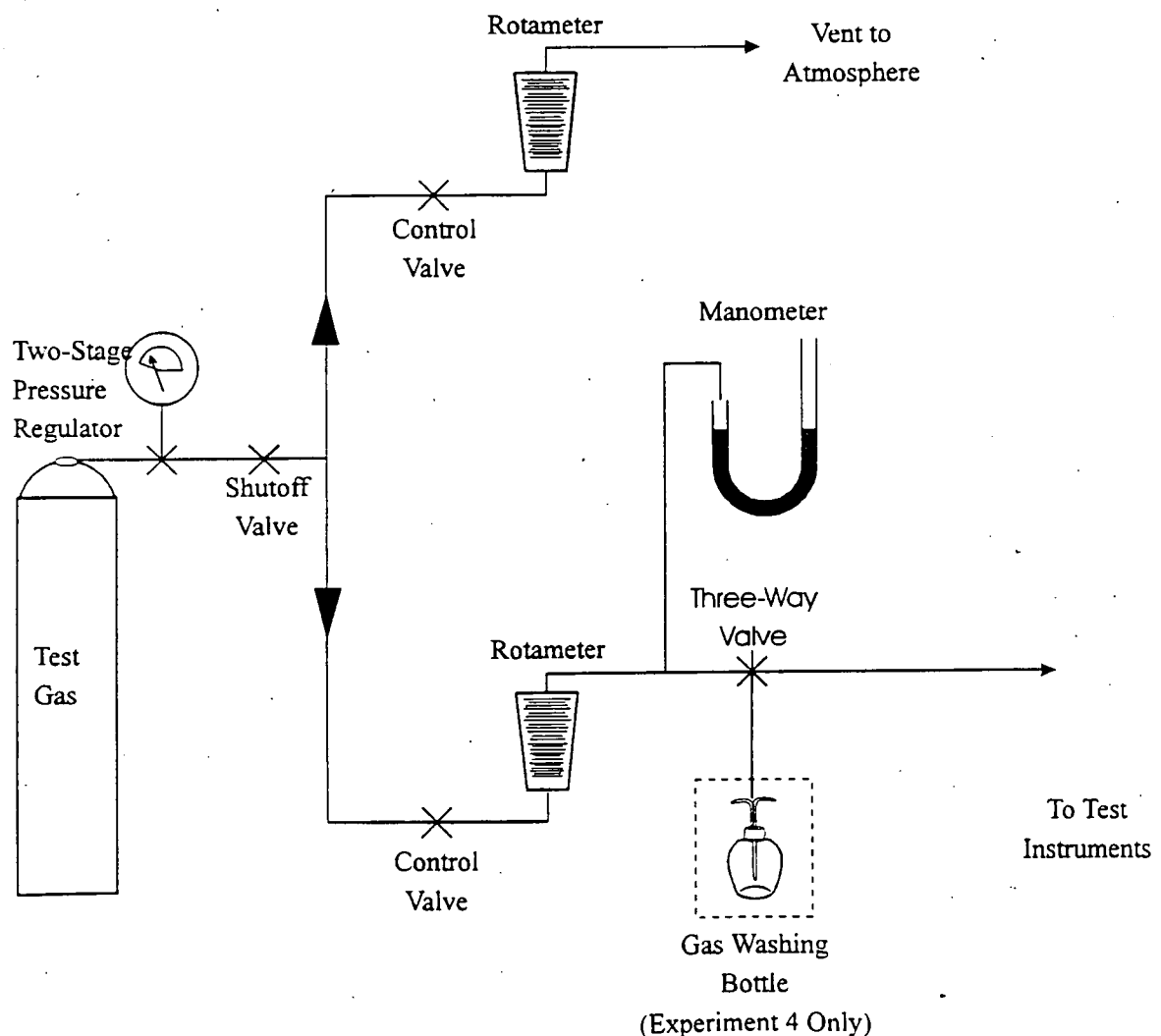
Manufacturer	Model	Calibration Gas	Lamp IP (eV)
HNu Systems, Inc.	DL-101	100 ppm	10.2
Photovac International	Micro-TIP HL-2000	250 ppm	10.6
Mine Safety Appliances	Photon	100 ppm	10.6
Thermo Environmental, Inc.	OVM 580B	250 ppm	10.6

We requested three copies of each instrument along with instructions, calibration and charging equipment, and minor service tools. We told manufacturers we would use their instruments in the condition received except for charging and calibration.

Apparatus

We used the equipment train shown in Figure 1 to deliver test gases at the required flow rates, which varied from instrument to instrument. We kept gas flow from the cylinder just above the instruments' required flow, so that a slight excess bled off to the atmosphere at all times. A manometer insured that sample gas was delivered at near-atmospheric pressure. For the experiment requiring humidified test gases, we inserted a gas washing bottle (250 ml tall form w/ fritted disc, Curtis Matheson Cat. No. 124-222) after the rotameter.

Figure 1 Gas Sampling Apparatus



Experiment 1 - Instrument Accuracy and Precision w/o Set Points (i.e. Calibration Using Manufacturers' Calibration Procedure to Read 2 Methyl propene (Isobutylene) Directly)

Procedure:

We first performed an experiment to compare the response of instruments under status quo operating procedures -- before set points leveled the playing field. Using 2 Methyl propene (Isobutylene) span gas, we calibrated instruments to read 2 Methyl propene (Isobutylene) directly, using the procedure recommended by the manufacturer. We then measured all six concentrations of each surrogate plus a zero-air blank. Measurements were made one time, using three copies of each instrument.

We calculated mean values of the three readings for each instrument/concentration combination and prepared plots of instrument readings vs. surrogate concentrations.

Experiment 2 Establishing Calibration Set Points

Procedure:

In this experiment we determined set points for each instrument and hydrocarbon product for use when calibrating the instrument against its manufacturer's recommended span gas. The set points chosen would cause the instrument to "read direct" the concentration of the hydrocarbon in the range of interest. To accomplish this we first connected Copy 1 of an instrument to the 25 ppm fuel oil surrogate and adjusted it to read "25 ppm" using the instrument's span or calibration adjustment. We then connected the instrument to the standard 2 Methyl propene (Isobutylene) span gas and recorded its reading. We repeated this twice more with Copy 1. We then repeated this procedure with Copies 2 and 3 and obtained a mean value of nine readings. This mean was established as the "dry" set point for that instrument for fuel oil. We next determined a "dry" gasoline set point using the 100 ppm gasoline surrogate and the same technique. We repeated the entire procedure for the remaining makes of instrument, producing "dry" fuel oil and gasoline set points for each product/instrument combination.

Experiment 3 Determining Precision, Accuracy, and Linearity of Test Instruments Using Experiment 2 Set Points

Procedure:

In a third experiment we first calibrated the test instruments to the Experiment 2 "dry" set points. We then used the instruments to measure gas concentrations from surrogate cylinders of 10, 25, 50, 100, 200, and 400 ppm for each hydrocarbon product plus a zero-air blank. These concentrations bracketed the notification levels and extended above to

examine instrument linearity at higher concentrations. We measured each concentration with all three copies of each instrument six times. We took three measurements each of two days, recalibrating instruments to the Experiment 1 set points at the beginning of each day's work.

We determined the mean instrument readings, ranges, and standard deviations for each concentration/instrument combination and prepared plots of instrument reading vs. surrogate concentration.

Experiment 4 Effect of Humidity Upon Instrument Accuracy and Precision

Procedure:

Moisture is well known to suppress the response of PID instruments, regardless of make or model. We had performed Experiments 1, 2 and 3 using essentially "dry" test gases. Since the headspace over most soil samples contains moisture, we felt it was necessary to evaluate whether moisture affected all instruments equally. If the effect were equal -- say a 25% across-the-board signal suppression -- the playing field would remain equal. However, if moisture depressed one instrument by 15 % and another by 35 %, we would need to adjust the set points of Experiment 2 to reflect that difference.

In a fourth experiment, we used the instruments, calibrated to the read 2 Methyl propene (Isobutylene) directly, to measure both dry and humidified surrogates. Each copy of each instrument measured all concentrations of the "dry" products plus a zero-air blank one time, as in Experiment 3. We then introduced a gas washing bottle into the sampling train and repeated the measurements. We determined the relative humidity of the dry and humidified gases by wet bulb/dry bulb method to be ~0 % and 86 %, respectively. We analyzed samples of the humidified gases to ensure that washing hadn't significantly changed their composition.

We calculated mean readings of the three dry and humidified readings for each instrument/product/concentration combination and prepared plots of the results.

Results and Discussion

Surrogate Design

The difficulties associated with preparing reproducible concentrations using weathered products and soil led to the surrogate approach. We designed the surrogates based on mass spectral analysis of weathered gasoline and # 2 fuel oil. The MS analysis shown in Tables 2 and 3 indicated that five classes of compounds existed in the products. The classes in gasoline are saturated hydrocarbons, unsaturated hydrocarbons, unsaturated

cycloparaffins or diunsaturates, and aromatics (BTEX). The classes in # 2 fuel oil are saturated hydrocarbons, cycloparaffins, unsaturated cycloparaffins or diunsaturates, and aromatics (BTEX). Each of the classes has a different ionization potential (IP) range. Since the ionization potential relative to the lamp voltage determines a PID's sensitivity to a compound, each one of the classes must be represented. Since the instruments do not resolve the compounds, the class may be represented by a single compound. The chosen compounds must have high vapor pressures to ensure that the mixtures exhibit stable concentrations as the gases are used. Tables 2 and 3 show the classes and their representatives. The total organic concentration in the surrogates ranged from 0 ppm to 400 ppm.

Table 2 Design of Gasoline Surrogates

Class	IP Range (eV)	Wt. % in vapor GC/MS	Surrogate	IP (eV)	Wt % in Surrogate (Spec.)
Saturated hydrocarbons	10 - 10.6	49.1	2 Methyl butane	10.32	50
Unsaturated hydrocarbons	9.1 - 9.6	20.6	2 Methyl propene	9.23	20
Unsat Cycloparaffins or Diunsat	8.8 - 9.1	8.6	Cyclopentene	9.01	10
Aromatics (BTEX)	8.4 - 8.8	21.7	Toluene	8.82	20

Table 3 Design of # 2 Fuel Oil Surrogates

Class	IP Range (eV)	Wt % in vapor GC/MS	Surrogate	IP (eV)	Wt % in Surrogate (Spec.)
Saturated hydrocarbons	10 - 10.6	47.0	2 Methyl butane	10.32	48
Cycloparaffins	9.8 - 10.1	32.0	Cyclopropane	10.06	32
Unsat Cycloparaffins or Diunsat	8.8 - 9.1	12.7	Cyclopentene	9.01	12
Aromatics (BTEX)	8.4 - 8.8	8.3	Toluene	8.82	8

The specification which we gave to the gas supplier is shown in Tables 2 and 3. The surrogates were analyzed using gas chromatography by the manufacturer and the Maine Health and Environmental Testing Laboratory (HETL). Tables 11 and 12 show the results of the HETL analysis. The concentrations are within specification according to the analysis by the HETL and the manufacturer's certificate of analysis. The analysis shows that the prepared gases are suitable for use as surrogates for weathered gasoline and # 2 fuel oil.

Experiment 1 Instrument Accuracy and Precision w/o Set Points ("Uncorrected")

Since anecdotal information suggested that significant differences existed between instruments, we first measured the instruments responses under standard, uncorrected conditions. The instruments when directly calibrated to 2 Methyl propene (Isobutylene) showed responses to the surrogates which varied from the laboratory assay. Tables 4 and 5 and Figures 2 and 3 show the data.

**Table 4 Uncorrected Values for Dry Gasoline Surrogates
(calibrated directly to 2 Methyl propene (Isobutylene))**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	2	19	36	79	150	275	473
Standard Deviation	0	3	7	16	28	52	58
Photon Gas Detector	1	13	23	29	91	176	360
Standard Deviation	1	3	3	5	12	18	40
MicroTIP Model HL-2000	1	11	21	46	91	179	374
Standard Deviation	0	1	1	1	3	3	6
Thermo OVM Model 580B	0	15	30	35	117	209	387
Standard Deviation	0	1	1	1	1	5	36

**Table 5 Uncorrected Values for Dry # 2 Fuel Oil Surrogates
(calibrated directly to 2 Methyl propene (Isobutylene))**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	5	32	37	55	94	169	290
Standard Deviation	0	6	7	11	16	29	47
Photon Gas Detector	3	20	26	53	59	110	210
Standard Deviation	1	2	7	5	8	12	20
MicroTIP Model HL-2000	3	10	17	30	56	106	212
Standard Deviation	0	1	0	1	2	1	3
Thermo OVM Model 580B	4	13	21	62	67	123	210
Standard Deviation	1	1	1	1	1	0	5

Figure 2 Uncorrected Gasoline Surrogate

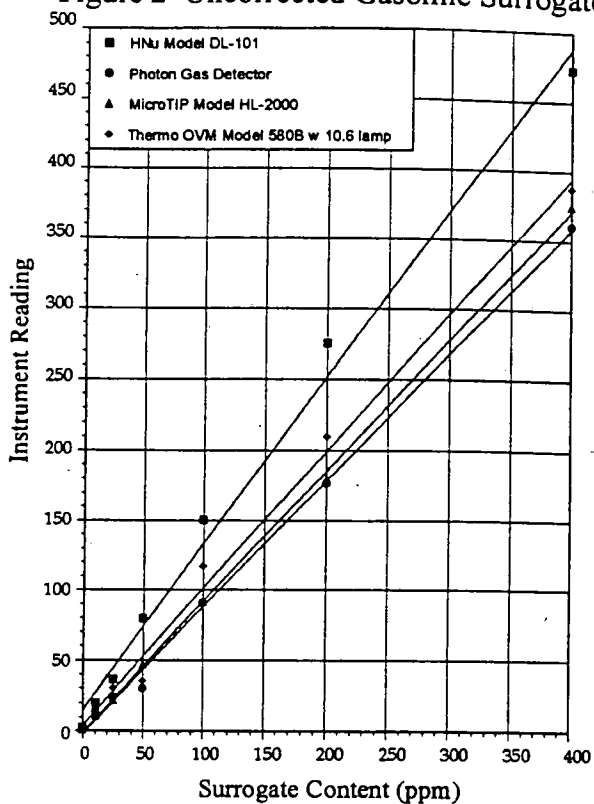


Figure 3 Uncorrected # 2 Oil Surrogate

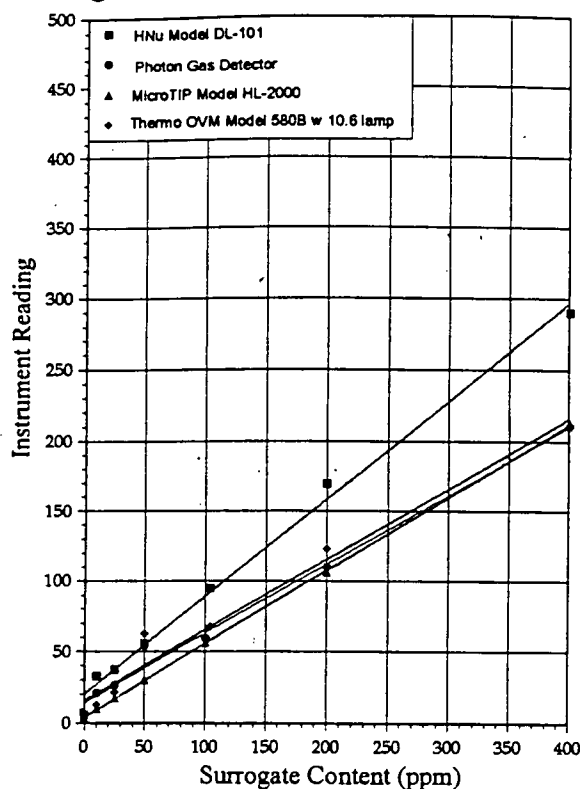


Figure 4 Corrected Gasoline Surrogate

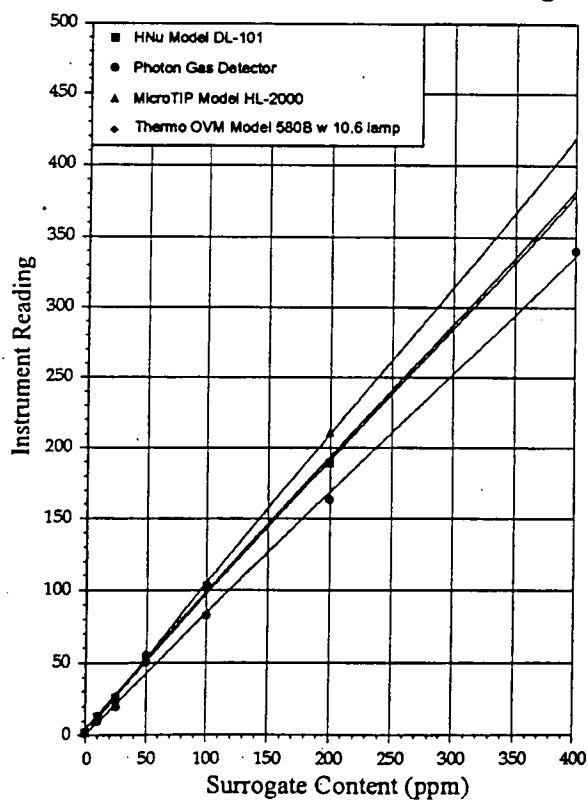
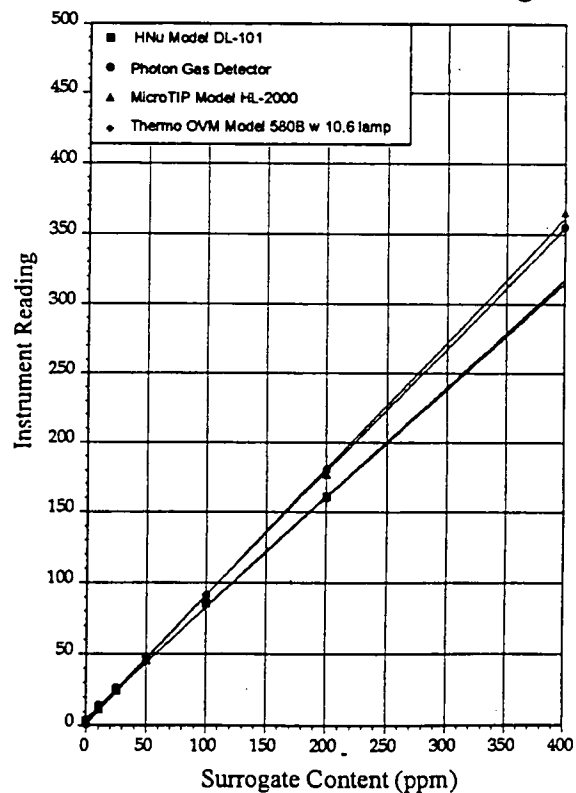


Figure 5 Corrected # 2 Oil Surrogate



The standard deviations show that the data is reliable. The Photon and MicroTIP had linear response to the surrogates to 400 ppm total organic content. The HNu DL-101 and the Thermo Environmental 580B had a lower response to the 400 ppm surrogates than expected. Therefore we only presented the 400 ppm data in the uncorrected graph for these instruments. This approach is valid since the area of primary interest is around the reportable levels where the response curves are linear for all instruments.

We expected differences between instruments for the gasoline and fuel oil response due to the different lamp voltages. However, we expected the 10.6 eV instruments to exhibit similar responses to gasoline and #2 fuel oil. When the lamp reaches its energy limit, the output begins to decrease. A 10.2 eV lamp should have a lower high energy output than the 10.6 eV lamp. Since some of the surrogate compounds have an IP in the range where the 10.2 eV lamp should have lower output, a lower response to these compounds was expected for the 10.2 eV lamp. The 10.6 eV lamp should have enough energy to ionize these compounds. Therefore a smaller difference between the gasoline and # 2 oil surrogates was expected for the instruments with a 10.6 eV lamp than those with a 10.2 eV lamp. There are substantial differences between the responses to the gasoline and #2 fuel oil surrogates for all instruments. The gasoline curves were in a range in which the instruments approximate direct reading for gasoline. The #2 fuel oil curves were lower than the gasoline curves. These results are consistent with the differences observed in the field between gasoline and #2 fuel oil responses. Although differences between the instruments exist, the results do not account for the reported field differences between the instruments at specific sites.

Experiment 3 Instrument Accuracy and Precision using Set Points ("Corrected")

We applied the calibration factors shown in Table 6 to the instruments and then measured the surrogates. The Table 6 set points were established in Experiment 2.

Table 6 Calibration Values used in the Corrected Experiments

Instrument	Calibration Gas (ppm)	Gasoline C _{dry}	# 2 Fuel Oil C _{dry}
HNu Model DL-101	100	63.9	96.5
Photon Gas Detector	100	99.0	155.7
MicroTIP Model HL-2000	250	271.0	423.0
Thermo OVM Model 580B	250	207.0	304.0

Application of calibration factors significantly reduced the differences between instrument readings and surrogate concentrations. The responses to both gasoline and #2 fuel oil surrogates were linear in the area of interest when we applied the correction factors. Tables 7 and 8 present the data. The standard deviations show that the data is reliable.

Figures 4 and 5 show the corrected response curves. The curves show that these instruments can be calibrated to read both gasoline and #2 fuel oil directly.

**Table 7 Corrected Values for Dry Gasoline Surrogates
(calibration factors shown in Table 6)**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	0	13	25	53	102	188	323
Standard Deviation		1	2	7	9	17	24
Photon Gas Detector	0	9	19	50	82	162	340
Standard Deviation		2	2	7	14	26	62
MicroTIP Model HL-2000	0	12	25	53	104	210	450
Standard Deviation		1	2	4	9	17	48
Thermo OVM Model 580B	0	14	27	56	104	190	330
Standard Deviation		2	2	3	4	5	10

**Table 8 Corrected Values for Dry # 2 Fuel Oil Surrogates
(calibration factors shown in Table 6)**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	3	12	24	45	85	160	279
Standard Deviation	1	2	3	7	13	23	35
Photon Gas Detector	1	14	26	47	90	180	355
Standard Deviation	0	4	4	4	8	18	28
MicroTIP Model HL-2000	3	11	24	45	89	176	365
Standard Deviation	2	1	2	2	4	11	21
Thermo OVM Model 580B	2	12	25	45	85	158	277
Standard Deviation	1	2	2	2	4	6	7

Experiment 4 Effect of Humidity Upon Instrument Accuracy and Precision

Since many field samples contain substantial amounts of moisture we determined the instruments' response to humidified surrogate gases. The atmosphere over the headspace is usually well humidified. The bags and jars in the field often have droplets on the walls produced by evaporation and condensation of soil moisture.

The presence of 85% humidity affected all of the instruments. The MicroTIP and the Photon were least affected by humidity. The Thermo 580B showed moderate affects. Humidity substantially reduced the responses of the HNu instruments. Figures 6, 7, 8 and 9 show the curves. Tables 13 and 14 present the attenuation values. The standard deviations show that the data is reliable. Since both the dry and humidified response curves are linear, the effects are more readily observable at high TPH contents. Investigators usually observe the most pronounced differences between instruments in the field at soil concentrations above notification levels. The presence of water vapor in the sample is a major cause of these differences.

**Table 9 Uncorrected Values for Humidified (85 % R.H.) Gasoline Surrogates
(calibrated directly to 2 Methyl propene (Isobutylene))**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	0	6	14	31	61	117	215
Standard Deviation	0	0	1	2	5	9	13
Photon Gas Detector	9	20	34	60	100	169	326
Standard Deviation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MicroTIP Model HL-2000	3	11	22	44	82	156	316
Standard Deviation	1	1	1	3	6	10	15
Thermo OVM Model 580B	0	9	18	39	76	146	272
Standard Deviation	0	1	3	6	6	12	39

**Table 10 Uncorrected Values for Humidified (85 % R.H.) # 2 Fuel Oil Surrogates
(calibrated directly to 2 Methyl propene (Isobutylene))**

Surrogate Content (ppm)	0	10	25	50	100	200	400
HNu Model DL-101	3	8	13	22	42	79	139
Standard Deviation	0	0	0	2	4	6	10
Photon Gas Detector	11.1	19.2	29.8	43.2	69.4	112	197
Standard Deviation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
MicroTIP Model HL-2000	7	11	20	32	58	107	202
Standard Deviation	1	1	1	2	3	8	13
Thermo OVM Model 580B	3	8	15	24	44	83	155
Standard Deviation	1	0	1	1	2	5	10

Samples of the dry and humidified surrogate gases were analyzed to ensure that the composition did not change as a result of the humidification process. Tables 11 and 12 show the results. This data shows that the humidification process did not affect the compositions. We do not know why the 200 ppm # 2 fuel oil humidified surrogate had

Figure 6 HNu DL-101

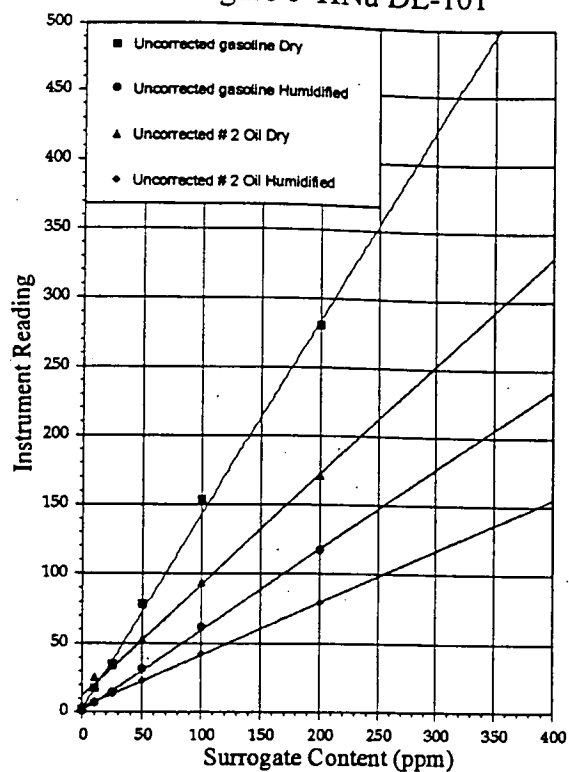


Figure 7 MSA Photon

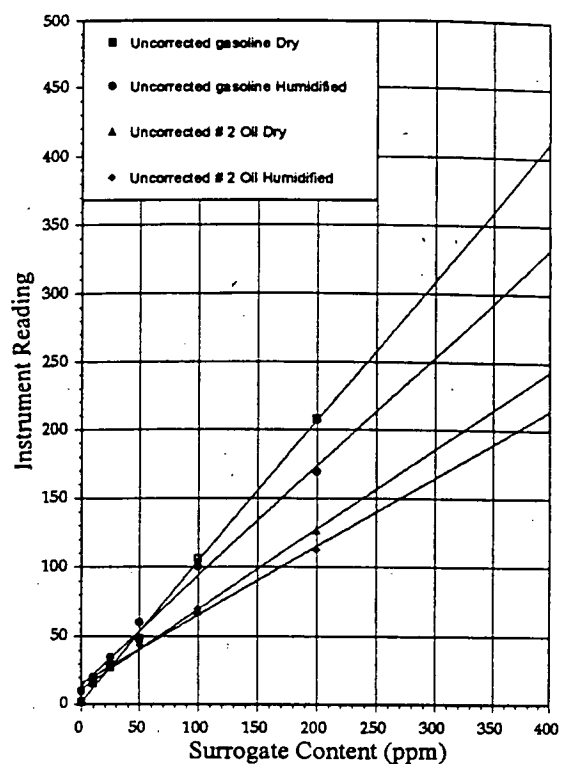


Figure 8 MicroTIP HL2000

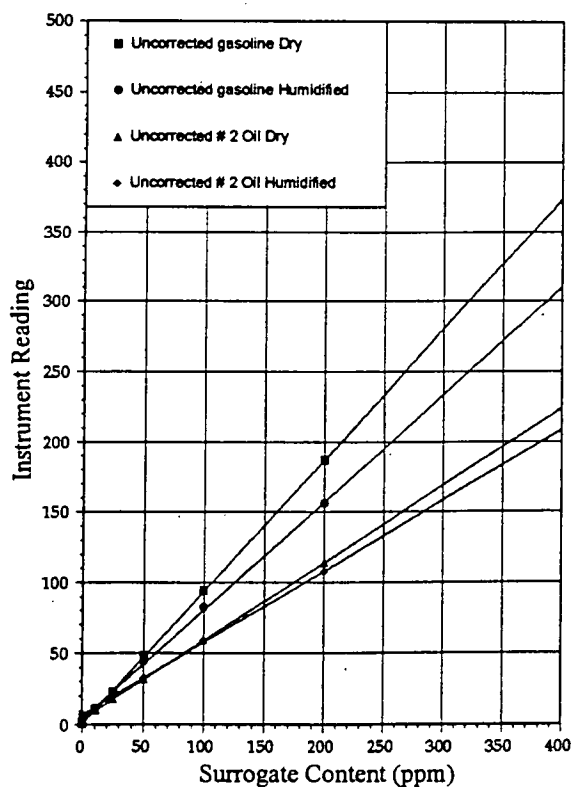
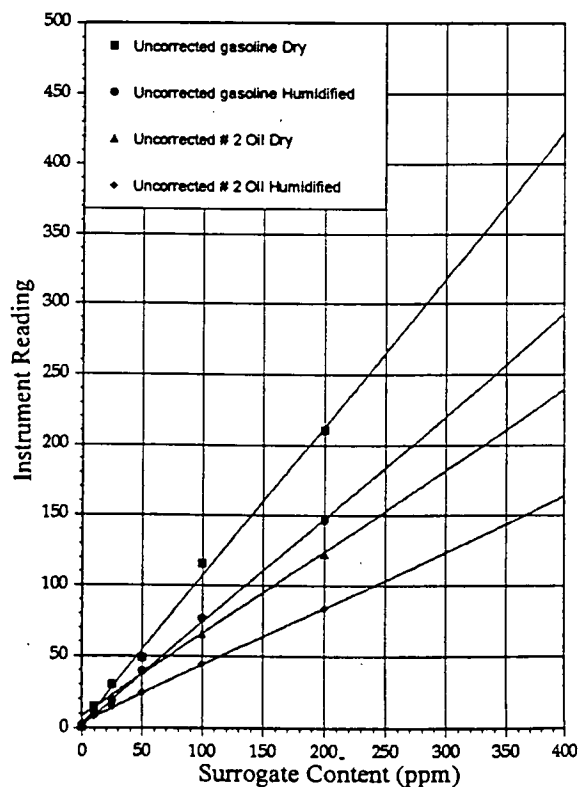


Figure 9 Thermo 580B



lower levels than the dry gas. The differences for all of the other gas samples are within the error of the analytical method. The response to the humidified 200 ppm #2 fuel oil surrogate appeared to follow the expected linear trend shown in the figures. The results were not affected by the changes in the humidified 200 ppm # 2 fuel oil surrogate. Since the composition of the surrogates remained stable, the attenuation of response is due to the water vapor in the sample.

Table 11 HETL Analytical Results for the Gasoline Surrogate

Compound	2 Methyl propene		2 Methyl butane		Cyclopentene		Toluene	
	Dry ppm	Wet ppm	Dry ppm	Wet ppm	Dry ppm	Wet ppm	Dry ppm	Wet ppm
10 ppm	0.6	0.7	5.2	5.2	0.9	1.0	1.4	1.6
25 ppm	1.3	1.5	12	11.8	1.7	1.8	3.0	3.7
50 ppm	10	8.2	25	23	4.0	3.0	8.0	5.6
100 ppm	21	20	56	53.8	9.4	8.3	19	17.3
200 ppm	39	39.9	110	107	17	17.3	36	34.1
400 ppm	81	73	220	228	37	40	68	70.4

Table 12 HETL Analytical Results for the # 2 Fuel Oil Surrogate

Compound	Cyclopropane		2 Methyl butane		Cyclopentene		Toluene	
	Dry ppm	Wet ppm	Dry ppm	Wet ppm	Dry ppm	Wet ppm	Dry ppm	Wet ppm
10 ppm	0.9	0.8	5	5.5	1.0	1.0	0.2	0.9
25 ppm	8.0	8.5	12	12.4	2.0	2.0	1.6	1.9
50 ppm	16	18.7	25	29	4.8	5.3	3.7	4.4
100 ppm	35	33	56	53	11.6	10.7	9	8.0
200 ppm	61	49	106	88	22.3	17.8	18	14.6
400 ppm	148	147	236	235	48	47.7	37	37.2

The addition of moisture to the sample affects the slope of the response curve only. Note that humidification of the sample does not result in an increase in the detection threshold. Therefore, compensation for the effects of moisture may be done by adjusting the calibration of the instrument to change the slope of the response curve. We adjusted the calibration values of Experiment 2 to compensate for the effect of humidity on each of the instruments. We calculated the reduction in signal using Formula 1, and adjusted the dry calibration value using Formula 2. Tables 13 and 14 show the values.

We used the 100 ppm value for gasoline and the 50 ppm value for # 2 fuel oil to calculate the corrected calibration values.

Formula 1
$$\frac{(m_{\text{dry}} - m_{\text{wet}})}{m_{\text{dry}}} = A$$

Formula 2
$$\frac{C_{\text{dry}}}{(1 - A)} = C_{\text{wet}}$$

where m = slope of the curve, A = signal attenuation, and C = calibration value

Table 13 Effect of Humidity on Calibration Values for Gasoline Surrogates

Instrument	Signal Attenuation (A)	C _{dry} 100 ppm	(1 - A) (Form. 1)	C _{wet} (Form. 2)
HNu Model DL-101	74 %	64	0.26	246
Photon Gas Detector	17 %	99	0.83	119
MicroTIP Model HL-2000	21 %	271	0.79	343
Thermo OVM Model 580B	32 %	207	0.68	304

Table 14 Effect of Humidity on Calibration Values for # 2 Fuel Oil Surrogates

Instrument	Signal Attenuation (A)	C _{dry} 50 ppm	(1 - A) (Form. 1)	C _{wet} (Form. 2)
HNu Model DL-101	54 %	96.5	0.46	209
Photon Gas Detector	27 %	156	0.73	213
MicroTIP Model HL-2000	11 %	423	0.89	475
Thermo OVM Model 580B	30 %	304	0.70	434

Older Instrument Models

We evaluated the HNu DL-101 and some of the older HNu instruments. These included the PI-101, HW-101 and ISPI-101. These older instruments were in various states of repair and proved troublesome. The calibration set point varied on the instruments. This affected the slope each time the instrument was calibrated. The instruments, when properly set-up, appeared to have similar characteristics to the DL-101. The response to the surrogates and the effect of humidity are similar to the DL-101. However, the older

instrument results were not reproducible and therefore we did not include them in this report. These instruments are steadily being retired. Therefore, we do not propose to investigate them further. Since the DL-101 and the older HNu instruments appear to have similar characteristics, the DL-101 set points will be used for all of the HNu instruments.

Conclusions

When the instruments are calibrated to read 2 Methyl propene (Isobutylene), all of the instruments have different response curves for gasoline and # 2 fuel oil. The response to # 2 fuel oil was always lower than the response to gasoline. Differences between instruments for a given product in a dry atmosphere appear to result from differences in the manufacturer's choice of the response curve slope.

The presence of water vapor (85 % relative humidity) in the sample has a different effect on each instrument. The Micro TIP and the Photon were least affected by humidity. The Thermo 580B was moderately affected by humidity. Humidity substantially reduces the response of the HNu instruments. Humidity appears to be a major cause of the differences between instruments that are observed in the field.

The slopes of the response curves could be adjusted to allow the instruments to provide a calibrated response to the dry gasoline and # 2 fuel oil surrogates. Since humidity only affected the slope of the response curve the effect of humidity can be compensated for by adjusting the calibration point. Instrument set points which are suitable for site industrial hygiene monitoring and soil head space analysis are shown in Table 15.

Table 15 Set Points for Calibration of PID Instruments Using 2 Methyl propene (Isobutylene) Calibration Gas

Instrument	Calibration Gas	Industrial Hygiene Monitoring		Headspace Analysis	
Instrument	Calibration Gas	Gasoline	# 2 Fuel Oil	Gasoline	# 2 Fuel Oil
HNu - All Models	100 ppm	65	95	245	210
Photon Gas Detector	100 ppm	100	155	120	210
MicroTIP Model HL-2000	250 ppm	270	425	345	475
Thermo OVM Model 580B	250 ppm	210	305	305	435

The industrial hygiene set points should be used to calibrate the instruments to establish the required continuous site air monitoring at contaminated sites. A calibrated PID may be used to make decisions about respiratory protection levels. Site action levels should be

set in accordance with your organization's policy and guidance from regulatory authorities including OSHA, NIOSH and ACGIH.

The headspace analysis set points should be used for Chapter 691 Appendix Q analytical methodology. These set points will allow comparison between instruments on a specific site.

Previous results may be corrected by determining the correction factor C_f shown in Formula 3 and multiplying it by the measured result $[P_m]$ to give the corrected result $[P_c]$.

Formula 3

$$C_f = \frac{C \text{ (Table 15)}}{C \text{ (used to calibrate instrument)}}$$

Formula 4

$$[P_c] = [P_m] \times C_f$$

This method will allow the correction of previous results for the effects of humidity and will allow comparisons between different instruments.

APPENDIX E
TARGET COMPOUND LIST

TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

NOTE: The values in these tables are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above the background noise. The quantitation limits in these tables are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

The CRQL values listed on the following pages are based on the analysis of samples according to the specifications given in Exhibit D. For each fraction and matrix, a brief synopsis of the sampling handling and analysis steps is given, along with an example calculation for the CRQL value. All CRQL values are rounded to two significant figures. For soil samples, the moisture content of the samples is not considered in these example calculations.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Volatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
1. Chloromethane	74-87-3	10	10	1200	(50)
2. Bromomethane	74-83-9	10	10	1200	(50)
3. Vinyl Chloride	75-01-4	10	10	1200	(50)
4. Chloroethane	75-00-3	10	10	1200	(50)
5. Methylene Chloride	75-09-2	10	10	1200	(50)
6. Acetone	67-64-1	10	10	1200	(50)
7. Carbon Disulfide	75-15-0	10	10	1200	(50)
8. 1,1-Dichloroethene	75-35-4	10	10	1200	(50)
9. 1,1-Dichloroethane	75-34-3	10	10	1200	(50)
10. 1,2-Dichloroethene (total)	540-59-0	10	10	1200	(50)
11. Chloroform	67-66-3	10	10	1200	(50)
12. 1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13. 2-Butanone	78-93-3	10	10	1200	(50)
14. 1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15. Carbon Tetrachloride	56-23-5	10	10	1200	(50)
16. Bromodichloromethane	75-27-4	10	10	1200	(50)
17. 1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18. cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19. Trichloroethene	79-01-6	10	10	1200	(50)
20. Dibromochloromethane	124-48-1	10	10	1200	(50)
21. 1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22. Benzene	71-43-2	10	10	1200	(50)
23. trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24. Bromoform	75-25-2	10	10	1200	(50)
25. 4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26. 2-Hexanone	591-78-6	10	10	1200	(50)
27. Tetrachloroethene	127-18-4	10	10	1200	(50)
28. Toluene	108-88-3	10	10	1200	(50)
29. 1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
30. Chlorobenzene	108-90-7	10	10	1200	(50)
31. Ethyl Benzene	100-41-4	10	10	1200	(50)
32. Styrene	100-42-5	10	10	1200	(50)
33. Xylenes (Total)	1330-20-7	10	10	1200	(50)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Note that the CRQL values listed on the preceding page may not be those

specified in previous CLP Statements of Work. These values are set at concentrations in the sample equivalent to the concentration of the lowest calibration standard specified in Exhibit D VOA. Lower quantitation limits may be achievable for water samples by employing the Statement of Work for Low Concentration Water for Organic Analyses.

VOLATILES

Water Samples

A 5 mL volume of water is purged with an inert gas at ambient temperature. The volatiles are trapped on solid sorbents, and desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/L:

$$(10 \text{ ug/L}) (5 \text{ mL}) (10^{-3} \text{ L/mL}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng on the GC column}$$

Low Level Soil/Sediment Samples

A 5 g aliquot of the soil/sediment sample is added to a volume of water in a purge tube, heated, and purged with an inert gas. The volatiles are trapped, and later desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/Kg:

$$(10 \text{ ug/Kg}) (5 \text{ g}) (10^{-3} \text{ Kg/g}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng on the GC column}$$

Medium Level Soil/Sediment Samples

A 4 g aliquot of soil/sediment is extracted with 10 mL of methanol, and filtered through glass wool. Only 1 mL of the methanol extract is taken for screening and analysis. Based on the results of a GC/FID screen, an aliquot of the methanol extract is added to 5 mL of reagent water and purged at ambient temperature. The largest aliquot of extract considered in Exhibit D is 100 uL. For a sample with compound X at the CRQL of 1200 ug/Kg:

$$(1200 \text{ ug/Kg}) (4 \text{ g}) (10^{-3} \text{ Kg/g}) = 4800 \times 10^{-3} \text{ ug} = 4800 \text{ ng}$$

This material is contained in the 10 mL methanol extract:

$$(4800 \text{ ng}) / 10 \text{ mL} = 480 \text{ ng/mL}$$

Of which, 100 uL are purged from the reagent water.

$$(480 \text{ ng/mL}) (100 \text{ uL}) (10^{-3} \text{ mL/uL}) = 480 \times 10^{-1} \text{ ng} = 50 \text{ ng on the GC column}$$

Note that for both low and medium soil/sediment samples, while it may affect the purging efficiency, the volume of reagent water used in the purging process does not affect the calculations.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Semivolatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
34. Phenol	108-95-2	10	330	10000	(20)
35. bis(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36. 2-Chlorophenol	95-57-8	10	330	10000	(20)
37. 1,3-Dichlorobenzene	541-73-1	10	330	10000	(20)
38. 1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39. 1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40. 2-Methylphenol	95-48-7	10	330	10000	(20)
41. 2,2'-oxybis (1-Chloropropane) #	108-60-1	10	330	10000	(20)
42. 4-Methylphenol	106-44-5	10	330	10000	(20)
43. N-Nitroso-di-n-propylamine	621-64-7	10	330	10000	(20)
44. Hexachloroethane	67-72-1	10	330	10000	(20)
45. Nitrobenzene	98-95-3	10	330	10000	(20)
46. Isophorone	78-59-1	10	330	10000	(20)
47. 2-Nitrophenol	88-75-5	10	330	10000	(20)
48. 2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49. bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50. 2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51. 1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52. Naphthalene	91-20-3	10	330	10000	(20)
53. 4-Chloroaniline	106-47-8	10	330	10000	(20)
54. Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55. 4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56. 2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57. Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58. 2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59. 2,4,5-Trichlorophenol	95-95-4	25	800	25000	(50)
60. 2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61. 2-Nitroaniline	88-74-4	25	800	25000	(50)
62. Dimethylphthalate	131-11-3	10	330	10000	(20)
63. Acenaphthylene	208-96-8	10	330	10000	(20)
64. 2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65. 3-Nitroaniline	99-09-2	25	800	25000	(50)
66. Acenaphthene	83-32-9	10	330	10000	(20)
67. 2,4-Dinitrophenol	51-28-5	25	800	25000	(50)
68. 4-Nitrophenol	100-02-7	25	800	25000	(50)

Previously known by the name bis(2-Chloroisopropyl) ether

		<u>Quantitation Limits*</u>			
			Low	Med.	On
		<u>Water</u>	<u>Soil</u>	<u>Soil</u>	<u>Column</u>
<u>Semivolatiles</u>	<u>CAS Number</u>	<u>ug/L</u>	<u>ug/Kg</u>	<u>ug/Kg</u>	<u>(ng)</u>
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	800	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	800	25000	(50)
76. N-nitrosodiphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenylether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	800	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	84-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3'-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	218-01-9	10	330	10000	(20)
90. bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10000	(20)
91. Di-n-octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd)pyrene	193-39-5	10	330	10000	(20)
96. Dibenz(a,h)anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

SEMIVOLATILES

Water Samples

A 1 L volume of water is extracted in a continuous liquid-liquid extractor with methylene chloride at a pH of approximately 2. This extract is reduced in volume to 1.0 mL, and a 2 uL volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 10 ug/L:

$$(10 \text{ ug/L}) (1 \text{ L}) = 10 \text{ ug in the original extract}$$

When the extract is concentrated, this material is contained in the 1 mL concentrated extract, of which 2 uL are injected into the instrument:

$$(10 \text{ ug/mL}) (2 \text{ uL}) (10^{-3} \text{ mL/uL}) = 20 \times 10^{-3} \text{ ug} = 20 \text{ ng on the GC column}$$

Low Soil Samples

A 30 g soil sample is extracted three times with methylene chloride/acetone at ambient pH, by sonication. The extract is reduced in volume to 1.0 mL, and a 2 uL volume is injected onto the GC/MS for analysis. For a sample with compound X at the CRQL of 330 ug/Kg:

$$(330 \text{ ug/Kg}) (30 \text{ g}) (10^{-3} \text{ Kg/g}) = 9900 \times 10^{-3} \text{ ug} = 9.9 \text{ ug}$$

When the sample extract is to be subjected to Gel Permeation Chromatography (required) to remove high molecular weight interferences, the volume of the extract is initially reduced to 10 mL. This 10 mL is put through the GPC column, and only 5 mL are collected off the GPC. That 5 mL volume is reduced to 0.5 mL prior to analysis. Therefore:

$$(9.9 \text{ ug/10 mL}) (5 \text{ mL}) = 4.95 \text{ ug}$$

This material is contained in the 0.5 mL extract, of which 2 uL are injected into the instrument:

$$(4.95 \text{ ug/0.5 mL}) (2 \text{ uL}) (10^{-3} \text{ mL/uL}) = 1.98 \times 10^{-2} \text{ ug} = 20 \text{ ng on the GC column}$$

Medium Soil Samples

A 1 g soil sample is extracted once with 10 mL of methylene chloride/acetone, which is filtered through glass wool to remove particles of soil. The filtered extract is then subjected to GPC clean up, and only 5 mL of extract are collected after GPC. This extract is reduced in volume to 0.5 mL, of which 2 uL are injected onto the GC/MS. For a sample with compound X at the CRQL of 10,000 ug/Kg:

$$(10,000 \text{ ug/Kg}) (1\text{g}) (10^{-3} \text{ Kg/g}) = 10 \text{ ug}$$

(continued)

Semivolatiles, Medium Soil. continued -

This material is contained in the 10 mL extract, of which only 5 mL are collected after GPC:

(10 ug) (5 mL/10mL) = 5 ug

The volume of this extract is reduced to 0.5 mL, of which 2 uL are injected into the instrument:

(5 ug/0.5 mL) (2 uL) (10^{-3} mL/uL) = 20×10^{-3} ug = 20 ng on the GC column

Eight semivolatile compounds are calibrated using only a four point initial calibration, with the lowest standard at 50 ng. Therefore, the CRQL values for these eight compounds are 2.5 times higher for all matrices and levels.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Pesticides/Aroclors	CAS Number	Quantitation Limits*		
		Water ug/L	Soil ug/Kg	On Column (pg)
98. alpha-BHC	319-84-6	0.05	1.7	5
99. beta-BHC	319-85-7	0.05	1.7	5
100. delta-BHC	319-86-8	0.05	1.7	5
101. gamma-BHC (Lindane)	58-89-9	0.05	1.7	5
102. Heptachlor	76-44-8	0.05	1.7	5
103. Aldrin	309-00-2	0.05	1.7	5
104. Heptachlor epoxide	1024-57-3	0.05	1.7	5
105. Endosulfan I	959-98-8	0.05	1.7	5
106. Dieldrin	60-57-1	0.10	3.3	10
107. 4,4'-DDE	72-55-9	0.10	3.3	10
108. Endrin	72-20-8	0.10	3.3	10
109. Endosulfan II	33213-65-9	0.10	3.3	10
110. 4,4'-DDD	72-54-8	0.10	3.3	10
111. Endosulfan sulfate	1031-07-8	0.10	3.3	10
112. 4,4'-DDT	50-29-3	0.10	3.3	10
113. Methoxychlor	72-43-5	0.50	17.0	50
114. Endrin ketone	53494-70-5	0.10	3.3	10
115. Endrin aldehyde	7421-36-3	0.10	3.3	10
116. alpha-Chlordane	5103-71-9	0.05	1.7	5
117. gamma-Chlordane	5103-74-2	0.05	1.7	5
118. Toxaphene	8001-35-2	5.0	170.0	500
119. Aroclor-1016	12674-11-2	1.0	33.0	100
120. Aroclor-1221	11104-28-2	2.0	67.0	200
121. Aroclor-1232	11141-16-5	1.0	33.0	100
122. Aroclor-1242	53469-21-9	1.0	33.0	100
123. Aroclor-1248	12672-29-6	1.0	33.0	100
124. Aroclor-1254	11097-69-1	1.0	33.0	100
125. Aroclor-1260	11096-82-5	1.0	33.0	100

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of Pesticides/Aroclors.

PESTICIDES/AROCLORS

Water Samples

A 1 L volume of water is extracted three times with methylene chloride or by a continuous liquid-liquid extractor. This extract is reduced in volume to approximately 3-5 mL, and diluted up to 10.0 mL with clean solvent. When Gel Permeation Chromatography is performed, only 5 of the 10 mL of extract are collected after GPC.

Regardless of whether GPC is performed, either 1.0 or 2.0 mL of the 10.0 mL of the original extracts are taken through the remaining clean up steps (Florisil and sulfur removal). The volume taken through Florisil cleanup and the final volume of the extract after the clean up steps depends on the requirements of the autosampler. If the autosampler can handle 1.0 mL final extract volumes, this is the volume taken through Florisil and the final volume. If the autosampler cannot reliably handle 1.0 mL volumes, the volume is 2.0 mL. When using an autosampler, the injection volume may be 1.0 or 2.0 μ L. Manual injections must use a 2.0 μ L injection volume.

For a sample with compound X at the CRQL of 0.05 μ g/L and an autosampler requiring a 1.0 mL volume:

$(0.05 \text{ } \mu\text{g/L}) (1 \text{ L}) = 0.05 \text{ } \mu\text{g}$ in the original extract

This material is contained in the 10.0 mL of extract:

$(0.05 \text{ } \mu\text{g}) / (10.0 \text{ mL}) = 0.005 \text{ } \mu\text{g/mL}$

Of which, only 1.0 mL is carried through the remaining clean up steps. For a final extract volume of 1.0 mL and a 1 μ L injection volume:

$(0.005 \text{ } \mu\text{g/mL}) (1 \text{ } \mu\text{L}) (10^{-3} \text{ mL/} \mu\text{L}) = 5 \times 10^{-6} \text{ } \mu\text{g} = 5 \text{ pg}$ on the GC column

Soil Samples

There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides/Aroclors. A 30 g soil sample is extracted three times with methylene chloride/acetone by sonication. The extract is reduced in volume to 10.0 mL and subjected to Gel Permeation Chromatography. After GPC, only 5.0 mL of extract are collected. However, as with the water sample described above, either 1.0 or 2.0 mL of that extract are subjected to the other clean up steps, so no loss of sensitivity results from the use of GPC. From this point on, the soil sample extract is handled in the same fashion as the extract of a water sample. For a sample with compound X at the CRQL of 1.7 μ g/Kg:

$(1.7 \text{ } \mu\text{g/Kg}) (30 \text{ g}) (10^{-3} \text{ Kg/g}) = 51 \times 10^{-3} \text{ } \mu\text{g} = 51 \text{ ng}$ in the original extract

This material is contained in the 10.0 mL of extract:

$(51 \text{ ng}) / 10 \text{ mL} = 5.1 \text{ ng/mL}$

(continued)

Pesticides/Aroclors, continued..

Of which, only 1.0 or 2.0 mL are carried through the remaining cleanup steps. For a final extract volume of 1.0 mL and a 1 uL injection volume:

$(5.1 \text{ ng/mL})(1 \text{ uL})(10^{-3} \text{ mL/uL}) = 5.1 \times 10^{-3} \text{ ng} \text{) } 5 \text{ pg}$ on the GC column.

For either water or soil samples, if the autosampler used requires a 2.0 mL final volume, the concentration in the 10.0 mL of extract above remains the same.

Using a 2 uL injection volume, twice the total number of picograms are injected onto the GC column. However, because the injection volume must be the same for samples and standards, twice as much material is injected onto the column during calibration, and thus the amount of compound X injected from the sample extract is equivalent to the amount of compound X injected from the calibration standard, regardless of injection volume.

If a single injection is used for two GC columns attached to a single injection port, it may be necessary to use an injection volume greater than 2 uL.

APPENDIX F
TARGET ANALYTE LIST

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit (1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

- (1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use - ICP

Instrument Detection Limit (IDL) - 40

Sample concentration - 220

Contract Required Detection Limit (CRDL) - 3

The value of 220 may be reported even though the instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibits B and E.

- (2) The CRDLs are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

APPENDIX G
UST SAMPLE DATA

CTO 151 - 4.9A

SUMMARY SAMPLE DATA PACKAGE

CLIENT	<u>HALLIBURTON NUS CORPORATION</u>
CASE	<u>BRUNS</u>
SDG	<u>BRU01</u>
LAB NO.	<u>41161</u>
ISSUED	<u>SEPTEMBER 13, 1994</u>

PACE New England, Incorporated
Hampton, New Hampshire

September 13, 1994

Halliburton NUS Corporation
Mr. Gordon Bullard
187 Ballardvale Street STE A-100
Wilmington, MA 01887

SAMPLE DELIVERY GROUP NARRATIVE

Case: BRUNS (NAS Brunswick, ME, CTO 151)
SDG: BRU01
Laboratory: PACE New England, Inc. of Hampton, NH

Lab Numbers: 41161
Protocol: NEESA Level C package with CLP Methodologies. LOTUS diskette.

Sample Receipt: Samples were received at PACE, Inc. on 8/11/94. Laboratory sample numbers were assigned for test parameters as listed on the sample table which follows this narrative. Sample shipments were checked for custody seal integrity and cooler temperature. Samples were checked for appropriate preservation and accuracy against the Chains-of-Custody provided. Other than the exceptions noted below, samples were received between 2-6° C and in good condition. In addition, Sample Receipt Condition Reports can be found with the Chains-of-Custody.

Shipment received 8/11/94 (41161): One cooler was received with one Chain-of-Custody. The temperature was measured to be 4.2° C. Custody seals were not present as the samples were delivered to PACE by Mr. Gordon Bullard. Water QC blanks and MS/MSD analyses are not present in this SDG as outlined in the Task Order defining this project.

Volatile Organic Analysis: Samples were analyzed within holding time and in accordance with the CLP OLM01.8 water method. The water had a pH > 2 which suggested that it may not have been field-preserved.

Standards and BFB tunes met CLP calibration criteria. The method blank contained a low level of methylene chloride. This common lab contaminant was reported with a "B" qualifier when detected in the associated sample. The level of blank contamination was acceptable according to the protocol.

Internal standard areas and surrogate recoveries were compliant for all analyses. Surrogate recoveries for the method blank was plotted on NEESA control charts and were found acceptable. No trends involving the blank of this SDG were evident.

Semivolatile Organic Analysis: The sample was extracted and analyzed within holding time under the CLP OLM01.8 water method. Standards and DFTPP tunes were compliant with CLP calibration criteria. Compound allowances in the calibrations were taken as follows:

-HMS-HP 08/26/94 initial cal.: 4-chlorophenyl-phenyl ether RRF120 = 0.390 and RRF160 = 0.360 (< 0.400) and RSD = 20.9% (> 20.5%); benzo(k)fluoranthene RRF160 = 0.511 (< 0.700) and RSD = 35.1%.

Since response factors exceeded 0.010 and deviations did not exceed 40%, the calibration remained compliant. The protocol states that up to four allowances may be taken per calibration.

The method blank was free of target contamination but contained some small nontarget peaks. Similar nontarget peaks found in sample chromatograms were reported with the

SDG Narrative
Case: BRUNS, SDG: BRU01

"B" qualifier when CAS numbers matched those reported for the blanks. Matrix spike analyses were not requested for this SDG.

Internal standard areas were compliant for all analyses. Surrogate recoveries in the method blank were within CLP limits. Surrogates in the sample FTAUST were diluted below detectable limits. The "commercial" surrogate mix was used to spike the samples. This resulted in acid surrogate concentrations of 100 ug/ml in the extract instead of 75 ug/ml. The recoveries were calculated accordingly. Surrogate recoveries for the method blank were plotted on NEESA control charts and found acceptable.

Due to extract viscosity, sample FTAUST was extracted down to a 5.0ml final volume instead of a 1.0ml volume. The extract received an additional 1/200 dilution due to high levels of nontarget analytes. This resulted in a 1000-fold total dilution. The nontargets consisted of hydrocarbons which eluted from six to fourteen minutes.

The reporting software caused the Form I sample data sheets to contain an extra trailing zero in the mass/volume field. Gram weights should be considered accurate to the tenth of a gram, and volumes to the milliliter.

Pesticide/PCB Analysis: Samples were extracted and analyzed within holding time by the CLP OLM01.8 water method. The extracts were analyzed simultaneously on two widebore capillary columns. Method and instrument blanks were free of contamination which would affect sample results.

One initial calibration was run and was fully compliant. CLP protocol makes allowance for the surrogates and two targets to fall between 20.0-30.0% in the IND standards. The following compound allowances were taken in the initial calibrations:

GC15 "C" initial calibration: beta-BHC = 24.0%RSD and Methoxychlor = 20.1%RSD.

GC16 "C" initial calibration: Methoxychlor = 23.8%RSD and Endrin Ketone = 22.0%RSD.

The continuing calibration check standards also met compliance criteria.

Blank surrogate recoveries were acceptable, despite falling below the advisory 60% limit. The recoveries were similar to those obtained historically for the method. Surrogates in the sample FTAUST were diluted below detectable limits.

Sample FTAUST was analyzed at a tenfold dilution due to nontarget compound interferences. Prior to extraction, a small oil-like layer was observed on the surface of the sample.

Spike recoveries in batch QC lab control sample LSP4014 were plotted on NEESA control charts and found acceptable.

Metals Analysis: The analytical protocol for metals analytes established for this project is compliant with the EPA CLP SOW (Document Number ILM03.0) except as noted below. Control charts are provided. A trend of more than eight LCSW points above the mean is noted for lead. No corrective action is required as the trend recoveries range from 96.7% to 103.8%. Matrix quality control was not performed on any sample pertaining to this SDG.

ICP Analysis: Samples were prepared in on water batch.

ICP Analysis: Samples were analyzed in one analytical sequence on the TJA01

SDG Narrative

Case: BRUNS, SDG: BRU01

on 08/16/94. No problems were encountered in the analysis of these samples.

Trace ICP Analysis: Samples were analyzed for arsenic, lead, selenium in one analytical sequence on the TJA02 on 08/25/94. Samples were analyzed for thallium in one analytical sequence on the TJA02 on 09/02/94. The percent recovery for lead in the ICSABF is 79.7% which rounds to 80% according to the CLP SOW, and is therefore acceptable.

Mercury Analysis: Samples were digested in one water batch. Samples were analyzed within holding time in one analytical sequence on 08/19/94. No problems were encountered in the analysis of these samples.

Statement of Compliancy and Data Authorization

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the Laboratory Manager or his designee, as verified by the following signature.



Richard Wellman, Operations Manager
PACE New England, Incorporated

9/13/94

September 13, 1994

SAMPLE TABLE

CLIENT ID.	MATRIX	PACE #	PARAMETERS
FTAUST	WATER	41161-001	GC/MS VOA
		41161-002	ACID EXTRACTABLES
			BASE/NEUTRAL EXTRACTABLES
		41161-003	PCBS
			ORGANOCHLORINE PESTICIDES
		41161-004	CLP METALS

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

FTAUST

Lab Name: PACE NEW ENGLA

Contract: NEESAC

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-1

Sampl wt/vol: 5.00 (g/mL) ML

Lab File ID: C4258

Level: (low/med) LOW

Date Received: 08/11/94

% Moisture: not dec.

Date Analyzed: 08/19/94

GC Column: SP1000 ID: 2.00 (mm)

Dilution Factor: 25.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	250	U
74-83-9	Bromomethane	250	U
75-01-4	Vinyl Chloride	250	U
75-00-3	Chloroethane	250	U
75-09-2	Methylene Chloride	280	B
67-64-1	Acetone	2000	
75-15-0	Carbon Disulfide	250	U
75-35-4	1,1-Dichloroethene	250	U
75-34-3	1,1-Dichloroethane	250	U
540-59-0	1,2-Dichloroethene (total)	250	U
67-66-3	Chloroform	250	U
107-06-2	1,2-Dichloroethane	250	U
78-93-3	2-Butanone	250	U
71-55-6	1,1,1-Trichloroethane	250	U
56-23-5	Carbon Tetrachloride	250	U
75-27-4	Bromodichloromethane	250	U
78-87-5	1,2-Dichloropropane	250	U
10061-01-5	cis-1,3-Dichloropropene	250	U
79-01-6	Trichloroethene	250	U
124-48-1	Dibromochloromethane	250	U
79-00-5	1,1,2-Trichloroethane	250	U
71-43-2	Benzene	250	U
10061-02-6	trans-1,3-Dichloropropene	250	U
75-25-2	Bromoform	250	U
108-10-1	4-Methyl-2-Pentanone	250	U
591-78-6	2-Hexanone	250	U
127-18-4	Tetrachloroethene	250	U
79-34-5	1,1,2,2-Tetrachloroethane	250	U
108-88-3	Toluene	250	U
108-90-7	Chlorobenzene	250	U
100-41-4	Ethylbenzene	250	U
100-42-5	Styrene	250	U
1330-20-7	Xyl ne (total)	250	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

FTAUST

Lab Name: PACE NEW ENGLA

Contract: NEESAC

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-1

Sample wt/vol: 5.00 (g/mL) ML

Lab File ID: C4258

Level: (low/med) LOW

Date Received: 08/11/94

% Moisture: not dec.

Date Analyzed: 08/19/94

GC Column: SP1000 ID: 2.00 (mm)

Dilution Factor: 25.0

Soil Extract Volume: (uL)

Soil Aliquot Volume: (uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
=====	=====	=====	=====	=====

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

FTAUST

Lab Name: PACE NEW ENGLA

Contract: NEESAC

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-2

Sample wt/vol: 930.0 (g/mL) ML

Lab File ID: H5943

L v 1: (low/med) LOW

Date Received: 08/11/94

% Moisture: decanted: (Y/N)

Date Extracted: 08/12/94

Concentrated Extract Volume: 5000 (uL)

Date Analyzed: 08/29/94

Inj ction Volume: 2.0(uL)

Dilution Factor: 200.0

GPC Cleanup: (Y/N) N

PH:

CONCENTRATION UNITS:

(ug/L or ug/Kg) UG/L

CAS NO.

COMPOUND

Q

108-95-2	Phenol	11000	U
111-44-4	bis(2-Chloroethyl)ether	11000	U
95-57-8	2-Chlorophenol	11000	U
541-73-1	1,3-Dichlorobenzene	11000	U
106-46-7	1,4-Dichlorobenzene	11000	U
95-50-1	1,2-Dichlorobenzene	11000	U
95-48-7	2-Methylphenol	11000	U
108-60-1	2,2'-oxybis(1-Chloropropane)	11000	U
106-44-5	4-Methylphenol	11000	U
621-64-7	N-Nitroso-di-n-propylamine	11000	U
67-72-1	Hexachloroethane	11000	U
98-95-3	Nitrobenzene	11000	U
78-59-1	Isophorone	11000	U
88-75-5	2-Nitrophenol	11000	U
105-67-9	2,4-Dimethylphenol	11000	U
111-91-1	bis(2-Chloroethoxy)methane	11000	U
120-83-2	2,4-Dichlorophenol	11000	U
120-82-1	1,2,4-Trichlorobenzene	11000	U
91-20-3	Naphthalene	11000	U
106-47-8	4-Chloroaniline	11000	U
87-68-3	Hexachlorobutadiene	11000	U
59-50-7	4-Chloro-3-methylphenol	11000	U
91-57-6	2-Methylnaphthalene	11000	U
77-47-4	Hexachlorocyclopentadiene	11000	U
88-06-2	2,4,6-Trichlorophenol	11000	U
95-95-4	2,4,5-Trichlorophenol	27000	U
91-58-7	2-Chloronaphthalene	11000	U
88-74-4	2-Nitroaniline	27000	U
131-11-3	Dimethylphthalate	11000	U
208-96-8	Acenaphthylene	11000	U
606-20-2	2,6-Dinitrotoluene	11000	U
99-09-2	3-Nitroaniline	27000	U
83-32-9	Acenaphth n	11000	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

FTAUST

Lab Nam : PACE NEW ENGLA

Contract: NEESAC

Lab Cod :

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-2

Sample wt/vol: 930.0 (g/mL) ML

Lab File ID: H5943

Level: (low/med) LOW

Date Received: 08/11/94

% Moisture: decanted: (Y/N)

Date Extracted: 08/12/94

Conc ntrated Extract Volume: 5000 (uL)

Date Analyzed: 08/29/94

Injection Volume: 2.0(uL)

Dilution Factor: 200.0

GPC Cleanup: (Y/N) N pH:

CONCENTRATION UNITS:

CAS NO.

COMPOUND

(ug/L or ug/Kg) UG/L

Q

51-28-5-----	2,4-Dinitrophenol	27000	U
100-02-7-----	4-Nitrophenol	27000	U
132-64-9-----	Dibenzofuran	11000	U
121-14-2-----	2,4-Dinitrotoluene	11000	U
84-66-2-----	Diethylphthalate	11000	U
7005-72-3-----	4-Chlorophenyl-phenylether	11000	U
86-73-7-----	Fluorene	11000	U
100-01-6-----	4-Nitroaniline	27000	U
534-52-1-----	4,6-Dinitro-2-methylphenol	27000	U
86-30-6-----	N-Nitrosodiphenylamine (1)	11000	U
101-55-3-----	4-Bromophenyl-phenylether	11000	U
118-74-1-----	Hexachlorobenzene	11000	U
87-86-5-----	Pentachlorophenol	27000	U
85-01-8-----	Phenanthrene	11000	U
120-12-7-----	Anthracene	11000	U
86-74-8-----	Carbazole	11000	U
84-74-2-----	Di-n-butylphthalate	11000	U
206-44-0-----	Fluoranthene	11000	U
129-00-0-----	Pyrene	11000	U
85-68-7-----	Butylbenzylphthalate	11000	U
91-94-1-----	3,3'-Dichlorobenzidine	11000	U
56-55-3-----	Benzo(a)anthracene	11000	U
218-01-9-----	Chrysene	11000	U
117-81-7-----	bis(2-Ethylhexyl)phthalate	4900	J
117-84-0-----	Di-n-octylphthalate	11000	U
205-99-2-----	Benzo(b)fluoranthene	11000	U
207-08-9-----	Benzo(k)fluoranthene	11000	U
50-32-8-----	Benzo(a)pyrene	11000	U
193-39-5-----	Indeno(1,2,3-cd)pyrene	11000	U
53-70-3-----	Dibenz(a,h)anthracene	11000	U
191-24-2-----	Benzo(g,h,i)perylene	11000	U

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

FTAUST

Lab Name: PACE NEW ENGLA

Contract: NEESAC

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-2

Sampl wt/vol: 930.0 (g/mL) ML

Lab File ID: H5943

Level: (low/med) LOW

Date Received: 08/11/94

% Moisture: decanted: (Y/N)

Date Extracted: 08/12/94

Concentrated Extract Volume: 5000 (uL)

Date Analyzed: 08/29/94

Injection Volume: 2.0(uL)

Dilution Factor: 200.0

GPC Cleanup: (Y/N) N

pH:

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

Number TICs found: 20

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 107415	2,4-PENTANEDIOL, 2-METHYL-	5.55	20000	JN
2. 111842	NONANE	6.49	12000	JN
3.	UNKNOWN	6.97	13000	J
4.	UNKNOWN	7.24	68000	J
5.	UNKNOWN	7.59	48000	J
6. 62016379	OCTANE, 2,4,6-TRIMETHYL-	7.68	130000	JN
7.	UNKNOWN	7.85	14000	J
8.	UNKNOWN	8.13	38000	J
9.	UNKNOWN	8.80	49000	J
10. 15869860	OCTANE, 4-ETHYL-	8.94	130000	JN
11. 17312822	UNDECANE, 4,6-DIMETHYL-	11.36	17000	JN
12.	UNKNOWN	11.86	26000	J
13.	UNKNOWN	12.05	13000	J
14. 2131422	NAPHTHALENE, 1,4,6-TRIMETHYL	12.09	16000	JN
15. 55045119	TRIDECANE, 5-PROPYL-	12.27	56000	JN
16. 15869940	OCTANE, 3,6-DIMETHYL-	12.63	19000	JN
17. 630013	HEXACOSANE	13.00	25000	JN
18. 31295564	DODECANE, 2,6,11-TRIMETHYL-	13.06	19000	JN
19. 26730121	TRIDECANE, 4-METHYL-	13.72	16000	JN
20. 54833237	EICOSANE, 10-METHYL-	14.41	13000	JN

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

FTAUST

Lab Name: PACE NEW ENGLA

Contract: NEESAC

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: BRU01

Matrix: (soil/water) WATER

Lab Sample ID: 41161-3

Sample wt/vol: 1000 (g/mL) ML

Lab File ID:

% Moisture: decanted: (Y/N)

Date Received: 08/11/94

Extraction: (SepF/Cont/Sonc) CONT

Date Extracted: 08/15/94

Concentrated Extract Volume: 10000 (uL)

Date Analyzed: 08/24/94

Injection Volume: 1.00 (uL)

Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH:

Sulfur Cleanup: (Y/N) N

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND	Q
319-84-6	alpha-BHC	0.50 U
319-85-7	beta-BHC	0.50 U
319-86-8	delta-BHC	0.50 U
58-89-9	gamma-BHC (Lindane)	0.50 U
76-44-8	Heptachlor	0.50 U
309-00-2	Aldrin	0.50 U
1024-57-3	Heptachlor epoxide	0.50 U
959-98-8	Endosulfan I	1.0 U
60-57-1	Dieldrin	1.0 U
72-55-9	4,4'-DDE	1.0 U
72-20-8	Endrin	1.0 U
33213-65-9	Endosulfan II	1.0 U
72-54-8	4,4'-DDD	1.0 U
1031-07-8	Endosulfan sulfate	1.0 U
50-29-3	4,4'-DDT	5.0 U
72-43-5	Methoxychlor	1.0 U
53494-70-5	Endrin ketone	1.0 U
7421-93-4	Endrin aldehyde	0.50 U
5103-71-9	alpha-Chlordane	0.50 U
5103-74-2	gamma-Chlordane	50 U
8001-35-2	Toxaphene	10 U
12674-11-2	Aroclor-1016	20 U
11104-28-2	Aroclor-1221	10 U
11141-16-5	Aroclor-1232	10 U
53469-21-9	Aroclor-1242	10 U
12672-29-6	Aroclor-1248	10 U
11097-69-1	Aroclor-1254	10 U
11096-82-5	Aroclor-1260	10 U

1
INORGANIC ANALYSIS DATA SHEET

FTAUST

Lab Name: PACE New England, Inc.

Contract:

Lab Code:

Case No.: BRUNS

SAS No.:

SDG No.: MBRU01

Matrix (soil/water): WATER

Lab Sample ID: 41161-004

Level (low/med): LOW

Date Received: 08/11/94

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	65.3	B		P
7440-36-0	Antimony	13.1	U		P
7440-38-2	Arsenic	2.1	U		P
7440-39-3	Barium	21.8	B		P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	1.6	U		P
7440-70-2	Calcium	69800			P
7440-47-3	Chromium	2.4	U		P
7440-48-4	Cobalt	2.8	U		P
7440-50-8	Copper	3.0	B		P
7439-89-6	Iron	7330			P
7439-92-1	Lead	14.9			P
7439-95-4	Magnesium	3000	B		P
7439-96-5	Manganese	419			P
7439-97-6	Mercury	0.16	B		CV
7440-02-0	Nickel	6.9	U		P
7440-09-7	Potassium	26300			P
7782-49-2	Selenium	3.1	U		P
7440-22-4	Silver	2.7	U		P
7440-23-5	Sodium	25000			P
7440-28-0	Thallium	3.1	U		P
7440-62-2	Vanadium	3.9	B		P
7440-66-6	Zinc	19.4	B		P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

APPENDIX H

NAVY RESPONSES TO REGULATORY AGENCY COMMENTS

SITE 11 - ACTION MEMORANDUM
NAS BRUNSWICK

NAVY RESPONSES TO U.S ENVIRONMENTAL PROTECTION AGENCY
COMMENTS DATED SEPTEMBER 19, 1994

GENERAL COMMENTS

1. *For purposes of categorization, the EPA would like to clarify that this is a "time-critical" removal action. A non-time critical removal action would require a more detailed engineering evaluation/cost analysis (EE/CA).*

Response: All references to "non-time-critical" removal action will be revised to read "time-critical".

2. *The EPA believes that while the test pits are open the Navy should take additional geotechnical samples that may provide technical information for the evaluation and/or design of future remedial alternatives.*

Response: The suggestion was considered. However, samples for geotechnical sample analysis will not be taken at this time. Samples will be collected in the future as necessary to evaluate remedial options.

3. *As for Applicable or Relevant and Appropriate Requirements (ARARs), under the National Contingency Plan in 40 CFR §300.415, removal actions require identifying and complying with federal and state ARARs to the extent practicable. Since Site 11 is still in the remedial process, it seems that the only ARARs for the removal action are possible disposal requirements related to the soil and debris that are to be excavated.*

The EPA suggests that a subsection on ARARs be placed following "Section 5.5 Contribution to Remedial Performance," and "Section 5.3 Waste Disposal" should be deleted and moved into this new subsection. Also, it should be noted that Site 11 is part of the Sites 4, 11, and 13 Operable Unit which is still in the remedial process, and a Focused Feasibility Study and Final ROD for this OU are scheduled for the future.

Response: As previously discussed at our meeting on June 9, 1994, ARARs will not be discussed in the Action Memorandum, but will be addresses in the Addendum to the Feasibility Study for Site 11.

4. *With regards to CERCLA mandated community relations activities during removal actions, the Navy should ensure that the following items be met: a public notice must be published in a local newspaper; the Action Memorandum filed in the Administrative Record; and a 30-day public comment period be held and response should be given to significant comments received during the public comment period.*

Response: The Draft Action Memorandum was placed in the Information Repository at the Curtis Memorial Library on August 22, 1994. A public notice was published in the Brunswick Times-Record on August 23, 1993 announcing a 30-day comment period from August 22, 1994 to September 22, 1994. No comments were received during the public comment period. The Final Action Memorandum will be placed into the Administrative Record following its signature.

5. *The field sampling plan should include the following elements:*

Calibration Procedure and Frequency.

- *Data Reduction, Validation and Reporting.*
- *Performance and Systems Audits.*
- *Preventive Maintenance.*
- *Data Measurement Assessment Procedure.*
- *Corrective Action.*
- *Quality Assurance Reports to Management.*

Response: a) Calibration procedures will vary depending upon the specific instruments used in the field as determined by equipment availability at the time of mobilization. Operation and maintenance manuals as well as calibration logs will be available for review in the field for the instrument used.

b) Data validation will not be performed at this time. Samples will be collected and analyzed in accordance with NEESA Level C protocols which is similar to EPA Tier IV QA/QC protocols.

c) Performance and system audits, Preventative Maintenance, Data Measurement, Assessment Procedures, Corrective Action, and Quality Assurance reports relate to quality assurance (QA) issues covered by corporate and contract required QA plans. This information will be available for reference at the site.

SPECIFIC COMMENTS

6. *Page 1-1, Third Sentence: Revise to read, "... intent to pursue a "time-critical" removal action..."*

Response: The referenced text has been revised as noted.

7. *Page 2-7: Revise section heading to read, "Federal and State Authorities Role."*

Response: The referenced text has been revised as noted.

8. *Page 4-1, First Sentence: Revise to read, "A time-critical removal action...."*

Response: The referenced text has been revised as noted.

9. *Page 5-2, Section 5.1.3 Soil Sampling, ¶ 2, Second Sentence: Specify how many samples will be collected from a "hot-spot" area in the excavation.*

0

Response: Section 5.1.3 has been revised to clarify the sampling strategy.

APPENDIX B - FIELD SAMPLING PLAN

10. *Page 3-1, 3.0 Field Investigation Task Descriptions & Table 3-1, Summary of Sampling and Analyses.*

Standardize the plan to indicate the exact methods of analysis. The first paragraph in Section 3.0 indicates that analyses will be in accordance with "EPA CLP Standard Methods". This is

confusing since there are CLP Methods and Standard Methods of Analysis. Further confusion is created with Table 3-1 which indicates that SW-846 Methods will be used.

Response: The referenced text has been revised as noted.

11. *The Table 3-1 refers to the TCL and TAL lists. Provide the exact list as a reference. The list must contain the compounds of interest, the limits of detection and the exact CLP SOW contract identification number.*

Response: TCL and TAL lists are presented in Appendix E and F, respectively.

Table 3-1 also lists Method 418.1 for the determination of TPH in soils. This method is designed for aqueous samples only and is not applicable to soils. Provide information which specifies how the soil samples will be prepared for TPH analysis.

Response: In response to comments from the Maine Department of Environmental Protection (MEDEP), MEDEP Method 4.1.2 or 4.2.14P has been substituted for EPA Method 418.1.

Note (2) indicates that NEESA QC Level C will be used for all samples. Describe in detail the analytical methods, the QA/QC techniques and the report deliverables. Define NEESA Level C QA/QC.

Response: Level C analytical support is designed to provide laboratory analysis using the standard EPA approved procedures other than current CLP routine analytical services (RAS). This level is used to obtain similar analysis to that of Level III with less documentation.

Generally the analyses performed using Level C (Level III) techniques are designed to provide confirmed identification and quantification of organic and inorganic compounds in water, sediment, and soil samples.

Level C (Level III) provides data for site characterization, environmental monitoring, confirmation of field data and to support engineering studies (e.g., design, modeling, and pilot/bench studies). In some specific cases, Level C (Level III) analyses can also provide data for risk assessment requirements.

Level C (level III) laboratory analysis provides the following:

- ▶ Data to support engineering design parameters
- ▶ Data for use in evaluation the site for further action, e.g., to determine the extent of environmental contamination
- ▶ Data for use in risk assessments
- ▶ Rapid turnaround of data may be available
- ▶ Detection limits for presence or absence of compounds comparable to Level IV (Level D).

Level C (level III) protocols all have built-in QA/QC, including calibration runs, surrogate standards, etc. External QA, which is also used for the CLP, is employed in the form of trip[blanks, replicate and duplicate samples, and blind spikes submitted with the samples.

The type of laboratory support available under Level C (Level III) ranges in sophistication from GC/MS instrumentation to the measurement of water quality parameters.

12. *Page 3-3, Table 3-2, Sample Container, Preservative, and Holding Time Requirements.*

The table specifies HCl as the preservative for SVOC and PCB/PEST for aqueous samples. Acid preservation is not required for SVOC and PCB/Pest analyses. Please correct.

Response: The referenced text has been revised as noted.

This table lists six months for TAL metal holding times. If mercury is a required analyte for this site, then, the holding time requirement must be changed to reflect 28 days for mercury and six months for all other metals.

Response: An additional note has been added to the table to address the concern.

13. *Page 3-5, Section 3.2, Soil Sampling.*

The text needs to describe the field sampling procedures in detail and specify the types of equipment to be used for this sampling activity or provide a reference.

Response: SOP GH-1.3 has been included in Attachment B of the Field Sampling Plan (FSP).

Specify the collection procedure for duplicate samples.

Response: Please refer to Section 7.0 of the Field Sampling Plan.

Volatile samples must not be homogenized prior to containerization.

Response: The referenced text has been revised as noted.

14. *Page 5-1, Section 5.0, Sample Equipment and Procedures.*

The text list six pertinent SOPs and provides four of them in Attachment B. The attachment needs to provide copies of SOPs SF - 1.2, - Sample Preservation and SF - 2.3, Decontamination of Chemical Sampling and Field Analytical Equipment.

Response: The above referenced SOPs have been included in the Field Sampling Plan.

APPENDIX B, ATTACHMENT C

15. *Standard Operating Procedure - Headspace Screening Procedure.*

The calibration procedure and frequency of calibration for the PID or FID must be presented.

Response: Calibration procedures will vary depending upon the specific instruments used in the field. Operation and maintenance manuals as well as calibration logs will be brought to the field along with the respective instrument used.

SITE 11 - ACTION MEMORANDUM
NAS BRUNSWICK

NAVY RESPONSES TO MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
COMMENTS DATED SEPTEMBER 19, 1994

GENERAL COMMENTS

1. *As we discussed, the reference to the RCRA Closure Order should be removed from the text.*

Response: The referenced text has been revised as noted.

2. *Please describe the fate of the bermed fire pit. Will it be destroyed and removed? Is it contaminated?*

Response: The concrete fire pit will remain in-place during the test pit work. The pit will be addressed during the final phase of the remedial action for this site. It is currently unknown if the pit is contaminated.

DETAILED COMMENTS

3. *The extent of the confirmatory magnetometer survey grid is not clear. How far will the 10-by-10 foot grid extend around the testpits? The confirmatory magnetometer survey should cover the entire area under investigation. The attached figure outlines the area the Navy should cover during the confirmatory survey. The area extends from 100N to 350N, and from 50 E to 350E on Figure 4-1 of the Site 11 Technical Memorandum (ABB-ES 1994). This is the minimum area that the Navy should survey. The Navy should base the final extent of the survey area on information collected during the drum removal. The survey area must extend far enough to eliminate interference of boundary effects within the area of interest.*

Response: The areas outside the designated test pits have been previously investigated by ground penetrating radar and magnetometer surveys to determine the existence of buried drums. As a confirmatory measure, several test pits were excavated in these areas to verify the absence of drums and containers. Therefore, additional magnetometer investigations in these areas is not necessary at this time. The Navy is planning to conduct the final survey only in areas opened during the removal action plus ten feet to each side of the excavation limits.

4. *What is the effective depth of penetration of the magnetic survey? If the effective depth of penetration is less than the depth to virgin soils, the Navy must identify an alternative technique for locating drums in the subsurface.*

Response: The effective depth of penetration of the magnetic survey is dependent on the instrument used and the depth and mass of the buried material. Based on the Navy's previous experience at NAS Brunswick, we estimate the depth of penetration for the proposed instrument to be 20 feet and the depth of groundwater to be 15 feet. If virgin soils or groundwater should extend below the effective depth of penetration and if test pits indicate drums and containers were buried below the effective depth of penetration at other test pit sites, additional investigative activities will be conducted in the future to determine if drums exist in this zone.

5. *Page 5-2, Section 5.1.3, Perform Test Pits. What is the fate of in-situ soils if contamination exists beyond the proposed one meter over-excavation from a visible source?*

Response: Contaminated soils extending beyond one meter from the potential source will be left in-place and be remediated at a future date.

6. *Page 5-3, Section 5.3, Waste Disposal. Transporters of hazardous material must be licensed through the State of Maine.*

Response: Transporters of hazardous material will be licensed through the State of Maine.

7. *Page 5-3, Section 5.4. The Department explained during the June 9, 1994 TRC meeting that the contents in the UST must be sampled to identify the contents of the tank. Has the Navy completed the sampling? If sampling has been done, are there any results available?*

Response: The tank has been sampled and analyzed. The tank contains approximately 4,500 gallons of oily water. A copy of the analytical report has been attached as Appendix G.

8. *Page 5-3, Section 5.4, UST Closure. The tank to be removed must be inerted with the amount of dry ice necessary to reduce the explosive atmosphere in the tank and should not be limited to specified weight as described in the text.*

Response: The specified amount of dry ice was determined based on the MEDEP's requirement of 1.5 pounds of dry ice per 100 gallons of tank capacity. This requirement is also recommended by the American Petroleum Institute and considered standard industry practice. However, the tank atmosphere will be continually monitored until the LEL is 20 percent or below. Additional dry ice will be added if necessary.

9. *Page 5-4. What will the fate of all the tank's residual waste and rinsate solution?*

Response: These materials will be disposed of in accordance State and Federal regulations.

10. *Page 5-4. There is a discrepancy in the text regarding the tank anchor slab. The text states that it will be removed and will be left on-site. Please clarify.*

Response: According to record drawings, the tank anchor slab was constructed on top of the tank. In order to remove the UST, the slab will be broken up and removed. However, once removed from the excavation, the concrete will be staged on site for disposal at a future date. If contamination is visibly evident, the concrete will be handled as described for contaminated soils.

APPENDIX B, FIELD SAMPLING PLAN

11. *Page 2-1, Section 2.0. Will all "hot spots" be subject to identification and characterization? How will "hot spots" outside the proposed test pit areas be identified and characterized?*

Response: Contaminated soils outside of the designated test pit areas will not be addressed during this phase of work.

12. *Page 3-1, Section 3.0, top paragraph. Placing the soils into a stainless steel bowl, then transferring the soil to the sample container is unacceptable for VOC samples. Field personnel must place VOC soil samples directly into the laboratory sample containers.*

Response: Agreed. The referenced text has been revised to provide clarification.

13. *Page 3-1, Section 3.1, first paragraph in this section. The text should include an explanation for selecting the second random sample.*

Response: A second sample will be collected from a random location within the excavation. The intent of the sample is to represent the general chemical nature of soils within the test pit area. The sample, although random, will be collected away from "hot spot" locations previously sampled. This sampling scheme will provide additional data as to the general profile of soil contamination at the site. The referenced text has been revised to provide clarification.

14. *Page 3-2, Table 3-1. Total Petroleum Hydrocarbon analysis by EPA method 418.1 is unacceptable. The Navy must use an analysis approved by the Department. Methods chosen must be similar to MEDEP Methods 4.1.2, or 4.2.14P. The Department must approve any variation from the MEDEP methods.*

Response: MEDEP Method 4.1.2 or 4.2.14P has been substituted for EPA Method 418.1.

15. *Page 3-3, Table 3-2. Sample containers for VOCs must have a Teflon septum in the cover.*

Response: Sample containers for VOCs will have a Teflon septum in the cover.

SITE 11 - ACTION MEMORANDUM
NAS BRUNSWICK

NAVY RESPONSES TO MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
COMMENTS DATED OCTOBER 7, 1994

1. *p. 5-1, Section 5.1.2:*

Excavations will be advanced through fill areas and discontinued when virgin soils or groundwater are encountered. The fill materials and virgin soils consist of sandy material which will be difficult to distinguish visually in the field. Are there any physical features associated with the virgin soils, such as stratification, which can be used to identify their presence?

Response: Based on previous test pit logs, color may be used as one indicator of natural or virgin soils. If virgin soils are not distinguishable, the excavation will be continued to groundwater.

2. *p. 5-3, section 5.3*

Representative samples will be collected from each drum and staged soil stockpiles and submitted for character disposal characterization analysis. The report does not specify what characterization methods will be used. There is no indication that analytical methods used to characterize soils collected from the test pits and UST excavation, referenced in Tables 3-1, 3-2, and 3-3, will also be used to characterize liquids or solids contained in the removed drums.

Would it be appropriate to perform hazard field categorization (i.e. pH, solubility, flammability) to determine the chemical compatibility of containerized materials prior to placing the drums in the staging area? This might not be important if the drums are immediately recontainerized in DOT overpack containers.

Response: A "representative" sample of the drum contents will be collected from similar waste streams based on physical characteristics and field screening results (e.g. pH, PID screening, solubility, reactivity). Additional parameters or criteria may be used as determined by the selected disposal contractor. Any container that is removed will be repackaged if the existing container is not suitable for shipment as defined by DOT.

3. *p. 5-3 & 5-4, Section 5.4 UST Closure:*

The UST removal must meet the requirements of Chapter 695. A site assessment must be performed by a Maine Certified Geologist in accordance with Appendix G of 695. Is Halliburton aware of this and do they have a Maine Certified Geologist on staff?

On Page 5-4 it is indicated that six soil samples will be collected on the walls and floor of the UST excavation and screened using approved headspace techniques. If the presence of contamination is indicated based on the screening, the samples will be submitted for laboratory analyses of VOCs, SVOCs, TAL metals, PCBs, and pesticides. The screening results will only indicate the presence of VOCs. Other contaminants may be present in soils that do not contain VOC contamination. Therefore, submittal of soils for analysis should also be based on visual observations.

Both headspace and visual screening of soils should be extended to include the pipeline excavation between the tank and the concrete-lined "burn area".

Response: a) Halliburton is aware of the requirement and will provide a Maine Certified Geologist as required by Chapter 695.

b) Field screening will also include field observations by the Maine Certified Geologist to determine the presence of contamination.

c) Sampling of soils from the pipeline excavation was not anticipated based on the following:

- ▶ Previous studies have provided analytical data for characterization of soils and groundwater in the vicinity of the pipeline.
- ▶ The pipeline was installed through a known zone of contamination (i.e. the original "burn area").
- ▶ Due to the age, design, construction, and operation of the pipeline (i.e. a large diameter (8 inch) drainage pipe, the pipeline was only used intermittently, the pipe was designed and used for non-pressure service (gravity drainage), and the tank contains oily water), significant contamination resulting from a pipeline break is not anticipated.

However, it was the Navy's intent that, if during removal, the pipeline is observed to be damaged (prior to removal) and, based on visual screening methods, soil contamination resulting from the damaged pipe is evident, then a soil sample will be collected and analyzed for the same parameters as described for the UST sample.

SITE 11 - ACTION MEMORANDUM
NAS BRUNSWICK

NAVY RESPONSES TO BRUNSWICK AREA CITIZENS FOR A SAFE ENVIRONMENT
COMMENTS by R.G. GERBER, INC. DATED SEPTEMBER 17, 1994

1. *Cover Letter, Cover Page & Title Page. The cover letter states that the subject document is a "draft" document. However, neither the title page nor the cover page indicate the document is a draft. The status of documents prepared by HNUS in the future should be clearly indicated on the cover and the title pages.*

Response: Each page of the document is stamped "DRAFT". However, the comment is acknowledged and will be addressed in future submittals.

2. *Page 1-1. It is unclear how the activities described in the subject document fit in the sequence of past and possible future investigations and remedial actions at Site 11. It appears that the actions described are limited to the removal of the buried drums and other material discovered during the 1993 investigations, and that sampling and geophysical surveys will only be conducted in the immediate vicinity of the known drum caches. If this is the case, it should be clearly stated in Section 1.0. The relationship of the removal action to future investigations and possible remedial measures should also be presented. For instance, in Section 5.1.3, the objectives of the soil sampling include the identification and characterization of "hot spots" that will require future remediation.*

Response: The referenced section has been modified to address the comment.

3. *Page 2-5. What is the source of the information presented in the first two paragraphs on the page? Have the contents of the 6,000-gallon fiberglass underground storage tank mentioned in the first paragraph been tested? If so, what are the results? If not, when will the contents be tested and by what methods? Has the drum storage area mentioned in the third paragraph been investigated? When did the practice of bringing the empty drums to the Defense Reutilization and Marketing Office reportedly start? The paragraph at the bottom of page 2-1 of the Health and Safety Plan (HASP) should also be included in Section 2.1.3 or 2.1.4 of the text to present a more complete picture of past disposal activities at Site 11 and the objectives of the removal action.*

Response: (a) The source of the information is a technical memorandum prepared by ABB Environmental Services, Inc. for the Navy in January of 1994 (see Reference section).

(b, c, d) The tank has been sampled and analyzed. The tank contains approximately 4,500 gallons of oily water. A copy of the analytical report has been attached as Appendix G.

e) There is no information available at this time that would indicate that there was a designated drum storage area at the site.

f) No information is available as to the exact date this practice began.

g) The referenced section has been modified to address the comment.

4. *Page 2-6. How does the RCRA closure order mentioned in Section 2.1.5 pertain to past, proposed, or future activities at Site 11: What are the objectives of the closure order, and how were they/will be met?*

Response: The closure order does not pertain to this project. All references to the closure order have been deleted.

5. *Page 2-7. In addition to the U.S. Environmental Protection Agency and the Maine Department of Environmental Protection, other members of the Technical Review Committee (TRC), including BACSE representatives, will also review the proposed removal action. What or who are the "local authorities" referred to in the title of Section 2.3?*

Response: The title to this section has been modified to accurately reflect the review authorities.

6. *Page 3-1. The text in Section 3.1 should be revised to reflect that, in addition to the volume of material remaining in the drums being unknown, the contents (and their potential hazards) of the drums remain to be determined.*

Response: The first paragraph of Section 3.0 currently reflects the unknown condition and contents of the drums.

7. *Page 5-1. How is "grossly contaminated" soil mentioned in the first paragraph defined? The description of the test pit activities in Section 5.1 should also include the removal of contaminated soil. Who will log the test pits? Will a Maine Certified Geologist be involved in the test pit activities?*

Response: a) The referenced section has been revised to address the comment.

b) Removal of contaminated soils is addressed in Section 5.1.2.

c and d) A geologist will log the test pits. However, the geologist logging the test pits will be working under the direction of a Maine Certified Geologist.

8. *Page 5-2. What is the rationale for specifying that soil within one meter of the potential source will be removed? Section 5.1.3 should reference Section 3.1 of Appendix B and specific sections of the SOPs in Attachment B of the HASP for additional information concerning sampling and field screening procedures. The criteria for soil sampling location selection, as well as how "clean" soils are defined, should also be clearly stated.*

Response: The criteria was established at the June 9, 1994 Technical Review Committee meeting and agreed to by all parties. As contaminated soil at the site will be addressed during future remedial phases the intent here is to remove localized and heavily contaminated soil resulting from a leaking drum or container.

9. *Page 5-3. The meaning of the first sentence of Section 5.2 is unclear. Does it mean that HNUS will perform the magnetometer survey after initial test pit excavation and drum removal but before backfilling? If test pit activities resume because magnetic anomalies are detected, will the final survey be conducted before backfilling? The confirmatory surveys should be performed before the excavations resulting from drum removal are backfilled in order to confirm that additional drums or other material are not buried at greater depth. Additional information concerning the capabilities of the instrument should be provided in order to properly evaluate*

the results. How far below the ground surface can reliable data be interpreted, and what are the site-specific factors limiting the effectiveness of the instrument?

Response: Test pit activities will be performed to a depth where either virgin soils or groundwater is encountered in locations previously identified to exhibit anomalies by geophysical testing. At this time it is not anticipated that burial of wastes would have extended below these depths. Additional magnetometer surveys will be performed to confirm that drums do not exist on the edges of those areas previously identified which may have been masked by interferences imposed by a concentration of drums or metallic debris in the test pit site.

Additional information regarding the specifications of the magnetometer instrument can be found in a previous response to MEDEP comments.

10. *Page 5-3. What are the criteria for selecting a "representative" sample for waste disposal characterization?*

Response: A "representative" sample will be a sample collected from similar waste streams based on physical characteristics and field screening results (e.g. pH, PID screening, solubility, reactivity). Additional parameters or criteria may be used as determined by the selected disposal facility.

11. *Pages 5-3 & 5-4. What State of Maine regulations apply to the removal of the 6,000-gallon underground storage tank? The second paragraph in Section 5.4 mentions that all free liquids will be pumped from the tank. How and where will they be pumped? How will the liquid be tested and disposed? How will the tank be cleaned? How will the six "hot spots" be selected for testing? References for the State of Maine headspace screening guidance documents that will be followed should be included and the specific procedure, if it differs from that described on the last page of the subject document, should be included for review and comment.*

Response: (a) Based on the registry of the UST, the MEDEP considers the tank to be a hazardous substance storage tank. Consequently, Maine Regulations 006-096, Chapter 695 apply to the closure.

(b) Pumping methods will be selected by the removal contractor but it is anticipated that the UST contents will be removed by vacuum to a Maine licensed transport vehicle

(c) The liquid has been tested. Analytical results are presented in Appendix G.

(d) Disposal will be performed in accordance with applicable state and federal regulations. The precise method of disposal has not been selected at this time.

(e) The tank currently contains oily water. The interior of the tank will be cleaned using clean potable water wash and rinse and in accordance with Maine guidance documents and standard industry practice.

(f) The six sample locations will be field determined by the Maine Certified Geologist based on criteria established in MEDEP tank closure and site assessment guidance documents.

(g) The Maine guidance document has been included as Attachment C of the Field Sampling Plan.

12. *Page 5-4. The project schedule described in Section 5.6 should also include reporting the results of the field activities and laboratory analysis to the Navy and the TRC.*

Response: The schedule presented only addresses the field work. Reports and other relevant deliverables will be distributed when received by the Navy. A Removal Action Report will be distributed following completion of the Removal Action. The Removal Action Report will include results of field activities, results of laboratory analysis, and the UST Closure Report.

13. *Appendix B, Field Sampling Plan, Page 1-1. The last sentence states that deviations from the Field Sampling Plan (FSP) must be approved by the HNUS Project Manager. Will the Navy and the regulatory agencies also have a say in any deviations from the FSP?*

Response: The Navy will be apprised of any deviations from the FSP.

14. *Appendix B, Field Sampling Plan, Page 3-1. What steps will be taken to minimize the loss of volatile organic compounds during the collection and handling of the soil samples? Why is the soil sample placed in a stainless steel bowl prior to transfer to sample containers? What are the specific conditions that will trigger the collection of more than two samples in a test pit? For example, how large does an excavation have to be for three or more soil samples to be collected?*

Response: (a, b) Samples for VOCs will be collected and transferred directly into sample containers.

(c) Section 5.1.3 has been revised to provide clarification.

15. *Appendix B, Field Sampling Plan, Page 3-5. How will the backfill materials (sand and gravel) be determined to be "clean"?*

Response: Materials supplied from off-site commercial gravel pit sources will be assumed to be clean.

16. *Appendix B, Field Sampling Plan, Page 5-1. What are IDW samples? Note the comment below regarding the need for a list of acronyms.*

Response: Investigation Derived Waste (IDW). A list of acronyms has been provided in the document.

17. *Appendix B, Field Sampling Plan, Page 7-1. What is "laboratory grade water"? Is it deionized water? Where will the trip blanks be filled? Is the sampling device dried once a rinsate blank is collected? Field blanks are typically collected to check for sample contamination caused by site-related conditions, such as exposure to fumes or vapors during sample collection.*

Response: (a,b) Section 7.0 has been revised to provide clarification.

c) Typically, the equipment is allowed to air-dry in the support (clean) zone.

d) As described in USEPA and NEESA guidance documents, field blanks are samples of the water used for decontamination and steam cleaning purposes.

18. *Appendix B, Field Sampling Plan, Page 9-1. Where will the drummed wastes and the dumpster be placed and how will their security be controlled? Where will the wastes be disposed?*

Response: (a,b,c) The locations of the storage areas will be onsite. The exact locations will be determined during mobilization.

c) The Naval Air Station is an active military base and general public access is restricted. Barrier warning tape will be used to delineate the perimeter of the work areas. Additional precautions will be taken to delineate and protect the open excavations.

(d) Off-site disposal locations will depend on the specific waste stream encountered. Disposal will be performed in accordance with applicable federal and state regulations.

19. *Appendix B, Health and Safety Plan, Page 4-2. The second paragraph should be revised to reflect that, while the work is being conducted outdoors, overexposure to fuel-related vapors can occur under certain local meteorological conditions and/or levels of contamination.*

Response: The suggestion has been taken under consideration.

20. *Appendix B, Health and Safety Plan, Page 4-4. Will there be a low exposure potential when magnetometer surveys are conducted near or in open test pits? (See comment above.)*

Response: Magnetometer surveys will not be performed near or in open test pits.

21. *Appendix B, Health and Safety Plan, Page 5-1. What type (make/model) of radiation survey meter will be used at the site and what are it's capabilities? How will background levels of radiation be determined? Results of the radiation monitoring should be included in HNUS' report concerning the results of the removal and sampling activities.*

Response: (a) The specific make and model will depend on equipment availability during mobilization. Capabilities will include detection of gamma radiation.

(b) Background levels of radiation will be based upon a radiological survey performed in June of 1994 by ABB Environmental Services, Inc.

22. *Appendix B, Health and Safety Plan, Page 6-1. Level C respiratory protection does not appear to be appropriate for the underground tank sampling and removal because it is not known what materials were collected in the tank (and may have been released to the soil adjacent to the tank or associated piping) and whether an air-purifying respirator would provide sufficient protection.*

Response: Based on the available information, a Certified Industrial Hygienist (CIH) has approved the selected levels of PPE. However, the level of PPE may be upgraded or downgraded based on specific site conditions observed at the time that field work is conducted.

23. *General Comment - a list of references, as well as a list of acronyms, should be added.*

Response: The suggestion has been incorporated into the document.